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INTERNATIONAL NOTATION IN ELECTRICAL ENGINEERING.

In the symbolic language of mathematics, or even of mathematical physics, it is undesirable to fetter the meaning of the symbols employed. It is far better to encourage freedom and originality of thought by allowing each writer to assign the meanings of the algebraic symbols he selects. In technology, however, when the mathematical concepts are stereotyped and the formulas are simplified into mental apparatus for dealing with specific structural and economic problems, there is an enormous advantage in retaining the same symbols for the same perpetually recurring quantities. In order that the ordinary notation of electrotechnical literature should be consistent and orderly in any one country, it is essential that it shall be standardized systematically in all the civilized countries of the world, because the tendency to follow the notation of foreign writers is constantly being experienced by writers in each land. Moreover, aside from the national viewpoint, it is of great international importance that all the fundamental electrotechnical literature should be couched in the same symbolic terms. Such unification in practice is not only more civilized and becoming to the inhabitants of one and the same planet, but also leads to clearer mutual understanding and appreciation of all the electrical engineers of the world.

It will be remembered that last year the conference of the International Electrotechnical Commission, at Brussels, unanimously recommended the international adoption of eight symbols in electrotechnics, representing respectively emf, quantity, inductance, magnetic force, magnetic flux-density, length, mass and time. No attempt was made to reach a decision upon symbols for the two important quantities, resistance and current, which enter into Ohm's law, because the usage of writers in different countries differed to some extent on these symbols. In Germany, *W*, the initial letter of *widerstand*, has been much used for resistance; while, in regard to current, writers in Great Britain have very generally used *C*, those in Germany *J* as well as *I*, and those in other countries *I* simply. The use of *C* for current in Great Britain has likewise prevented the use in that country of *C* for capacity, as generally employed in other countries of the world.

We learn that at a recent conference held in Europe, between delegates of the International Electrotechnical Commission from Belgium, France, Germany and Great Britain, a mutual understanding was reached that Great Britain would accept *I* for current and *C* for capacity, if Germany would accept *R* for resistance and *I* for current, to the exclusion of *W* and *J*. This paves the way for complete international agreement on the symbology of Ohm's law, as well as on the eight symbols already agreed upon at Brussels. This agreement, if ratified at Turin this year, will prove not only a great achievement for the International Electrotechnical Commission, but also a great international asset. Hitherto we have all had one and the same international ohm, volt and ampere, but now we shall hope to

have international symbols for their embodiment in electrotechnical literature.

THE BOOM IN ELECTRIC VEHICLES.

The last year has seen a very notable increase in the number of electric vehicles in service and their more general distribution. In several cities vigorous efforts are being made to exploit this particular phase of electric service with, on the whole, rather promising results. Of late some of the runabouts have been making remarkable records for distance covered between charges, but at the present time the electric vehicle, whether truck or touring car, is particularly recognized as a vehicle of convenience, not ordinarily adapted to covering very long distances or running at very high speed, but immensely handy and workable within its limitations. This recommendation is enough to insure steadily increasing use even if no material improvements on the present equipment are made; but that which we here want to point out is tthat the essential thing for the successful operation of electric vehicles of every kind is the existence of frequent and convenient charging stations.

So far as pleasure vehicles are concerned one of the chief advantages of the electric type is that it can be operated by anybody and the services of a chauffeur are not required. This means that the majority of such cars will find their way into the hands of persons who are themselves operators, and it is the arrangements made for their convenience that will very largely determine the success of the present boom. Now, when one brings home a car at, let us say, 10:30 p. m., with the battery pretty well exhausted, he does not want to take it three-quarters of a mile to a garage where charging energy is available and ride home on the street cars. He either should be able to run the car into his own little garage and charge it there, or take it a block or two to a convenient charging point. The number and convenient location of public and private charging points will determine the fate of the electric pleasure vehicle. If a suitable automatic equipment can be installed in each private garage much will have been accomplished toward success. At present the high cost of most charging outfits stands in the way of their general use.

Even an electric vehicle requires occasional overhauling, and the class in the community most likely to buy electric vehicles is the very one least likely to wish to undertake the personal care of them; hence the necessity for more numerous and conveniently placed charging stations where minor overhauling can be quickly and readily done. To a less degree the same condition holds for business vehicles. If the electric central stations desire to promote a large use of energy for this class of transportation, they must be prepared, either directly or indirectly, to see to it that charging points are installed at numerous convenient points and that preparations are made to recharge systematically and take care of the vehicles in the vicinity. If charging stations could readily be found in every town where there is electric service, the use of electric pleasure cars on fairly long runs would become very much more common than it now is. In the absence of such conveniences long runs are out of the question and the whole proposition becomes essentially confined pretty strictly to city limits. It is not enough to boom the sale of electric vehicles and acquaint the public with their indubitable advantages. One must go further and make the use of such vehicles as easy in practice as it is in theory, and this requirement implies singularly good facilities for charging and care, frequent enough to relieve the owners of any considerable burden in the matter.

INDUCTANCE OF THREE-PHASE TRANSMISSION LINES.

When a circuit is composed of two parallel wires at a uniform distance apart, with terminal generator and motor apparatus as in the simplest form of direct-current circuit, the emf of self-induction, when the current in the circuit varies, is the rate of change of magnetic flux threading and linked with the circuit loop. In the case of a direct-current circuit in the steady state, this emf of self-induction disappears, and only makes its appearance when the current in the circuit is started or stopped. This was one of Faraday's brilliant experimental discoveries. In the case of a single-phase alternating-current circuit, the current is, of course, perpetually changing, and consequently the emf of self-induction due to change of flux linkage with the loop is always being cyclically developed. The emf of self-induction, as is well known, lags behind the current one-quarter cycle in phase, if magnetic hysteresis in iron is eliminated from consideration. The vector emf of self-induction may therefore be added in proper phase to the vector impressed emf in order to obtain the resultant emf in the single-phase circuit, which, in turn, sends current through the resistance of the circuit by Ohm's law. We may, however, ignore the emf of self-induction explicitly, as is a common practice among engineers, and introduce in its place a certain imaginary resistance called reactance into the circuit, compounded of the angular velocity and the inductance, in such a manner as virtually to alter the ohmic resistance into an impedance, and such that the impressed emf acting on this vector impedance produces the actual current strength calculated according to Ohm's law when two-dimensionally interpreted.

It is a known proposition in electric-circuit technology that the self-induction of a single-wire line, constituting the outgoing conductor of a circuit, is not altered by splitting up the return conductor into a plurality of parallel elements, provided that the said elements all lie at the same distance from the axis of the outgoing conductor as the original return conductor. Consequently, when we take three wires and suspend them at equal distances apart, or at the edges of an equilateral prism, the self-induction of one of them, taken as outgoing conductor, will be the same, whether the current returns on either or on both of the two other wires. Thus, in a three-phase line system, when the three wires are symmetrically separated equilaterally, the self-induction of all three wires is the same, although at different portions of the current cycle the current divides in varying shares between the two return conductors. This means that the emf of self-induction bears the same symmetrical relation to the impressed emf on each side of the three-phase system, both as to magnitude and relative phase. But when the three wires of a three-phase system are not symmetrically separated equilaterally the three-line self-inductors will differ, and the three emfs of self-induction, on the three sides of the system, will differ. This dissymmetry of induced emf constitutes in itself an unbalancing element in the system, so that

the resulting system tends to become unbalanced in currents as well as emf, thereby introducing secondary dissymmetry and further complicating the relations.

In his interesting article on page 1607, Mr. Alfred Still discusses the frequently recurring practical case of a three-phase line comprising three equidistant wires in one place. This is the condition when the three wires are suspended from three insulators, which are equally spaced along one and the same cross-arm at each pole of an aerial line. In such a case the middle wire has clearly less self-induction, reactance and induced emf than the two outers. The article clearly shows that a certain relatively simple form of dissymmetry in emf is thus set up in the three induced emfs of the system. Moreover, when the three conductors are symmetrically transposed, so that each becomes the middle wire, at regular intervals along the line, the dissymmetry in inductance, reactance and induced emf disappears, and the line becomes once more balanced. For short lines, with moderate spacing, this is the simplest disposition to follow. When, however, two or more separate three-phase lines occupy different cross-arms on the same pole, then the transpositions must be effected so as not only to symmetrize the emfs induced within each three-phase system, considered alone, but also the emfs that are induced mutually between the separate systems.

A STUDY OF LIGHTNING.

The coming season, which brings worry to the mind of the central-station operator, also brings opportunities for the investigator which ought not to be neglected. Considering the familiarity of lightning, its frequent occurrence, and its power for mischief, it is rather remarkable that so little is known of its real characteristics, and that so much of what is supposed to be known is not so. Only a few years ago there was a general impression that lightning flashes were oscillatory discharges of high frequency, and that protective measures to be effective must be planned accordingly. It is now well established that the magnitudes involved in lightning flashes are not such as correspond to high-frequency oscillations, although the steepness of the current wave may lead to secondary phenomena of vastly greater frequency than would be indicated by the character of the discharge as a whole. Some recent experiments by Dr. Walter, a German investigator, throw a new light upon the multiple flashes, which seem to be the nearest approach to the character of oscillatory discharge of which lightning is ordinarily capable.

Dr. Walter investigated the subject by means of two cameras, one fixed and the other shifting at a known rate. When a lighning flash was trapped by this device, both cameras, of course, gave the same form; but in the case of a multiple flash the moving camera registered a series of images from which the time constants of the discharge can be computed. The exact nature of these multiple flashes is somewhat mysterious, yet it is perfectly clear that they take place in virtue of the ionized lane of air established by the first discharge. At all events the phenomenon is a somewhat deliberate one. One of Dr. Walter's photographs showed five flashes with an average, somewhat irregular, interval of about one-tenth second. One occasionally sees similar phenomena, sometimes between clouds, showing a sheaf of discharges reminding one strongly of a photograph of a sheaf of electric sparks from an induction coil. When seen these generally give clearly the impression of being consecutive phenomena, taking place within perhaps a small fraction of a second, but being enormously deliberate compared with anything to which one could fairly call high frequency. Both such discharges and those more common ones presenting the characteristics of a single flash deserve more study than they have yet received. While a lightning flash has the general nature of a condenser discharge, the capacities concerned appear to be of terrific dimensions, and the electrical characteristics of the clouds which serve as the condenser plates are very slightly known. It would be a very interesting and important study to determine as well as may be the general magnitude of the capacities and resistances involved. Dr. Walter's method applied at two stations, from which not only the periods of the discharges, but their actual lengths, could be determined, would put in our hands a very large amount of valuable information. Further than this, observations on the induced discharges along lines bearing an ascertainable relation to the path of the flash and automatically recorded should give a far more definite idea of the magnitudes involved than would be yielded by any ordinary process of estimate or calculation. Such data might in addition give useful information about the strength of the air as a dielectric when great potentials are involved. Our present experimental region is so far removed from the magnitudes involved in lightning that extrapolation from laboratory results is extremely hazardous. From a practical standpoint, too, it is certainly most desirable to know the approximate magnitudes of the various quantities which must be dealt with in planning lightning protection.

What, for example, are the magnitudes involved in the ordinary lightning stroke as observed on overhead lines, which is usually not a direct lightning stroke at all, but a phenomenon of induction? What are the electrical characteristics of these discharges, and are they within the region in which preventive measures are possible? The subject has a direct commercial value, for one avertible bad shutdown may involve loss which would pay for a deal of experimenting to find the conditions of prevention. With all the infinite variety of societies and committees whose energies are directed toward investigating natural phenomena, we think there is room for more active efforts than have yet been displayed regarding the systematized study of lightning. There are some committees charged with looking into the matter, but nothing yet like a general coordination of the efforts of investigators, such as might yield results of the highest theoretical and practical importance. The world knows little yet about even the simplest form of the terrific phenomena of lightning and still less about the more strange and unusual forms of which the theoretical bearings are of extraordinary interest. How about globular lightning, for example, a rare but well-attested phenomenon, of which the movements appear to be as deliberate as those of the ordinary flash are instantaneous? And how about that first cousin of the lightning, the corposant, known since the times of the Romans, and other freaks of atmospheric electricity, indicating forces in action far beyond the usual, and in action, too, under conditions practically unknown? The whole subject is one fraught with interest for the scientific investigator, and of direct value to the electrical industries. It is time for united effort for the solution of the curious and intricate problems involved in the thunderstorm.

A. I. E. E. Convention in Chicago.

Preparations are now practically complete for the annual convention of the American Institute of Electrical Engineers to be held at the Hotel Sherman, Chicago, June 26-30. The complete technical program was given in these columns in the issue of June 1, and announcement may now be made of the final arrangements for the entertainment features. During the week there will be ten business sessions, as follows: Tuesday morning, power stations; Tuesday evening, electric lighting; Wednesday morning, railways; Wednesday afternoon, industrial power and telephone and telegraph (parallel sessions); Thursday morning, high-tension transmission; Thursday evening, conference of officers and section delegates; Friday morning, general and high-tension transmission (parallel sessions); Friday afternoon, educational.

On the evening of Monday, June 26, there will be a general reception at the Hotel Sherman, followed by dancing. Light refreshments will be served. On Tuesday afternoon there will be a circular tour by train, including the Hawthorne works of the Western Electric Company and the Fisk and Quarry Street stations of the Commonwealth Edison Company. A train will leave the Union Station in time to take the party to the Hawthorne Works for luncheon, afterward conveying the party to the generating stations, returning by train to the Union Station.

On Wednesday at 1 p. m. there will be a complimentary luncheon to the members of the American Institute of Electrical Engineers by the Electric Club of Chicago. This luncheon will be served in the Hotel Sherman, and there will be four or five five-minute addresses and a musical program. At 2 p. m. on Wednesday the ladies are invited to visit the Art Institute, where there will be a reception, gallery tour and tea. All visitors and ladies in the families of local members are invited to attend.

A third event on Wednesday will be the boat trip on Lake Michigan for both ladies and gentlemen. The fine steamer *United States* has been chartered and will leave its dock not far from the Hotel Sherman at 8:15 p. m. There will be music and dancing on board, as well as a special entertainment. If the weather is unfavorable the party will be entertained on the boat at the dock.

A luncheon for the visiting ladies at the South Shore Country Club has been arranged for Thursday. The party will leave the hotel in automobiles at 11 a. m., going through the South Side boulevards and parks to the South Shore Country Club, which is pleasantly located on the shore of Lake Michigan, south of Jackson Park. Luncheon will be served here and there will be a special entertainment for those in attendance. Returning, the automobiles will take the ladies to their respective hotels.

On Thursday afternoon members of the Institute are invited to go as guests of the General Electric Company to Gary, Ind., by special train. The great electrically operated rolling mills of the Indiana Steel Company here, driven by electric motors which are perhaps the largest to be found in the world, will be inspected.

Several golf clubs having links in or near Chicago have extended the privileges of their grounds to visitors during the convention. There is every indication that there will be an exceptionally large attendance at the Chicago convention, and with the carefully arranged programs of business sessions and entertainment it is expected that this year's convention will be one of the most profitable and enjoyable in the history of the Institute. Mr. H. M. Byllesby is chairman of the entertainment committee.

Chicago has been honored with only one previous convention of the Institute, and that as far back as 1892. The members in that city have made elaborate and careful preparation for this meeting, and they assure all their fellow members in other localities that they will have no occasion to regret attendance at this Western convention, for which the arrangements are unusually complete.

New York Electrical Exposition.

Arrangements have been completed for holding the New York Electrical Exposition of 1911, from Oct. 11 to 21, at the New Grand Central Palace, Lexington Avenue and Forty-sixth Street, as noted in our issue for March 23. The exposition has received the indorsement of the Edison Electric Illuminating Company of Brooklyn, the New York & Queens Electric Light & Power Company, the Northern Westchester Lighting Company, the Peekskill Lighting & Railroad Company, the Public Service Electric Company, the Richmond Light & Railroad Company, the Bronx Gas & Electric Company, the Electric Vehicle Association of America, the New York Edison Company, the United Electric Light & Power Company, the Yonkers Electric Light & Power Company and the Westchester Lighting Company.

The exposition building, which has recently been completed, is of such a size as to accommodate 200,000 people daily. The entire first floor will be devoted to a variety of exhibits similar to those given in the Madison Square Garden during the past four years. On the second floor articles will be shown in the process of actual manufacture, with electricity as a basis of operation. The third floor will be devoted almost exclusively to the electric automobile industry.

The president of the exposition is Mr. Arthur Williams, and the vice-president and general manager is Mr. George F. Parker, who now maintains headquarters at 124 West Forty-second Street, New York.

Long-Distance Wireless Telegraphy.

In a recent lecture on radiotelegraphy before the Royal Institution, London, Mr. Marconi gave an insight into the present state of the art of long-distance wireless telegraphy. Air condensers have been adopted at Clifden and Glace Bay and have effected economies in working and in energy losses. It was found to be neither economical nor efficient to attempt to obtain continuous waves. Much better results are obtained when groups of waves are emitted at regular intervals in such manner that their cumulative effect produces a clear musical note in the receiver, which is tuned not only to the periodicity of the electric waves transmitted, but also to their group frequency. Persistency of oscillations is obtained by employing an apparatus consisting of a metal disk having metal studs firmly fixed at regular intervals in its periphery and placed transversely to its plane. This disk is caused to rotate rapidly between two other disks by means of a motor or turbine and the side disks revolve in a plane at right angles to that of the middle disk. The studs are of such length as just to touch the side disks in passing. The frequency employed at Clifden is 45,000, and when a potential of 15,000 volts is used on the condenser, the spark-gap is practically short-circuited during the time in which one complete oscillation only is taking place, when the peripheral speed of the disk is about 600 ft. per second. The primary circuit, therefore, continues oscillating without material loss by resistance in the spark-gap.

An interesting feature of the Clifden plant is the regular employment of high-tension direct current for charging the condenser. Direct current at a potential capable of being raised to 20,000 volts is obtained by means of special direct-current generators. These machines charge a storage battery of 6000 cells, all connected in series. Each cell has a rating of 40 amp-hours. When the cells are used alone the working voltage varies from 11,000 volts to 12,000 volts, and when the generators and battery are employed together the potential might be raised to 15,000 volts by using the gassing voltage of the battery. The potential at which the condenser is charged reaches 18,000 volts, due to the presence of choke coils between the battery or generator and the condenser. Satisfactory insulation is obtained by dividing the battery into small sets of cells placed on separate stands suspended on insulators attached to girders fixed to the ceiling of the battery-room.

A curious result noticed in long-distance work is the effect produced by daylight on the propagation of electric waves over great distances. According to Professor Fleming, the effect should be more marked on long than on short waves, but Mr. Marconi has found the reverse to be true. In some trans-atlantic experiments in which waves about 8000 m long were used the energy received by day at the distant receiving station was usually greater than that obtained at night. Recent observations tend to show that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly or southerly direction differing from those obtained when transmitting east or west. With wave-lengths of 7000 m and 5000 m the strength of the received wave remains steady, as a rule, during the day. Shortly after sunset at Clifden they become gradually weaker and about two hours later are weakest. They then begin to strengthen again and reach a very high maximum about the time of sunset at Glace Bay. They then gradually return to normal, but through the night remain very variable. Shortly before sunrise at Clifden they begin to strengthen and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases until it reaches a marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

Mr. Marconi is of the opinion that there is no foundation for the statement to the effect that the earth connection is detrimental to good tuning. A bad earth connection damps out the oscillations due to its resistance, and in that way makes tuning difficult, but no such effect is noticed when an efficient earth connection is employed. The earth wire may have a condenser or its equivalent in series with it.

Waterway and Water-Power Issue in Illinois.

Governor Deneen called a special session of the Illinois Legislature, which met on June 14. The object of the session is the consideration of legislation necessary to carry out the provisions of the constitutional amendment authorizing the issuing of $20,000,000 of State bonds to provide funds for the construction of a deep waterway along the Illinois River, between Lockport and Utica, Ill., and the development of water-power incident thereto. This is a subject which is very near to the Governor's heart. After a stormy session the State Senate passed the Johnson deep-waterway bill at an all-night session extending into the morning of June 16. The bill had not passed the lower house at this writing, however, that chamber having adjourned until June 21. The proposed deep waterway would be about 61 miles long, with a depth of 14 ft. The work of construction would be vested in five commissioners, and water-power leases are to be made by these commissioners only after the water-power plants shall have been completed substantially by the State. Then ninety days' public notice shall be given by public advertising for bids for such water-power. No water-power lease shall be made for a period exceeding ten years.

Ohio Telephone Situation.

Mr. Rollo R. Stevens, of Columbus, Ohio, has been appointed by the American Telephone & Telegraph Company as agent for the connecting companies in Ohio. For several years Mr. Stevens has been division sub-license agent of the Central Union Telephone Company and has been concerned in all the agreements made in that time for connecting the toll lines of the Central Union and American Telephone & Telegraph Companies with Independent exchanges. Since the administrative offices of the Bell and associated companies have been moved to Chicago Mr. Stevens will probably be the principal Bell representative in Ohio and as such will have charge of all consolidations of Bell and Independent exchanges and toll-line connections. He will also be the representative of the Bell companies before the Public Service Commission and will aid it in making preparations for the many consolidations that, it is believed, will be made within the near future.

It is said to be the policy of the Bell interests to secure and place before the commission all the data that can possibly be secured in cases of consolidation. Plenty of time will be taken for this work in order that the commission may have the fullest knowledge of every such transaction. While these data are being prepared the commission will have time to complete its organization for its new duties and will get down to a practical working basis. Nothing will be offered it for consideration by the telephone people until it is fully equipped for handling it. While it is said that some of the Independents are in a hurry to present propositions of this kind, they will not be entertained by the Bell interests until everything is in proper shape.

The annual meetings of the stockholders of the United States and Cuyahoga telephone companies will be held on July 10. The voting trust agreements expire on July 1 and, as most of the legal entanglements have been arranged, it is believed that the interests controlled by J. P. Morgan & Company will come into actual power and that plans for the future will be decided upon. No annual meetings have been held for two years, because of the suits pending against the new owners, but the public utilities bill recently enacted will make it possible to effect consolidations under proper conditions and no further trouble is anticipated.

Electrical Equipment of the Largest Vessel in the World.

The steamship *Olympic*, of the White Star Line, which sailed on her maiden trip from Southampton to New York on June 14, is the largest vessel in the world, having a gross tonnage of about 45,000. She is 882.75 ft. long, 92 ft. wide and 64.5 ft. deep. Her speed is 21 knots and she has three screws, two driven by two sets of triple-expansion, reciprocating engines and a center screw driven by a Parsons exhaust-steam turbine. The total horse-power is 46,000. The exhaust-steam turbine, which is placed in a separate engine-room abaft of the reciprocating engine-room and separated from it by a watertight bulkhead, receives steam at 9 lb. absolute and expands it down to 1 lb. absolute. The rotor, built up of steel forgings, weighs about 130 tons and has a diameter of 12 ft. The blades, ranging in length between 18 in. and 25.5 in., are built on the segmental principle, laced on wire through the blades and distance pieces at the roots and with binding soldered on the edge. The length between the extreme edges of the first and last rings of blades is 13 ft. 8 in. The speed is 165 r.p.m. when 16,000 hp is developed.

For generating electrical energy there are four 400-kw dynamos arranged at tank-top level in a separate watertight compartment aft of the turbine-room between the central and wing propeller shaft. Each is directly coupled to a 580-hp vertical, three-crank, compound engine running at 325 r.p.m. In addition there are two emergency 30-kw dynamos placed in a recess off the turbine-room at saloon-deck level well above the water line. The energy at 100 volts is distributed over a single-wire system and is controlled from a main switchboard in the electric engine-room. Electricity is employed not only for lighting and heating, but also for driving no fewer than seventy-five fans for ventilation, in addition to numerous electric cranes and winches for cargo purposes.

Electric Vehicle Club Meeting.

At the regular weekly meeting of the Boston Electric Vehicle Club on June 14 Mr. W. C. Wallace, Jr., of the Lansden Motor Car Company, presided. The usual luncheon was held in the Edison building, and at its close a free discussion took place upon present commercial developments in the Boston situation.

Attention was called to the increasing magnitude of the display of enlarged electric commercial and pleasure-vehicle photographs in the Boston Edison company's appliance exchange. About twenty views are now on exhibition, and arrangements are being made to provide for their special show-window display in rotation. A protracted discussion took place regarding the location of charging sets in the general Boston territory. It was pointed out that by installing a 40-amp tube on a 30-amp rectifier outfit Edison batteries can be successfully charged, and garages equipped with 30-amp outfits can thus render their service more inclusive. Mr. L. R. Wallis, Boston Edison company, stated that the company was most anxious to install charging equipment wherever anything like a reasonable use of its facilities could be anticipated. He briefly discussed the company's policy regarding the location of such stations, and said that it has been decided to remove all such apparatus from the substations, although in no case will facilities in a given town for electric-vehicle charging be diminished. On a system as large as that of the Boston company the interruption of substation operators' duties to charge vehicles is simply out of the question.

Mr. W. E. Eldredge, Boston, distributed blanks to the members providing for the tabulation of data of actual operating costs and fixed charges of vehicles of from 1000 lb. to 10,000 lb. capacity, running on one or two batteries in a daily service of from 25 miles to 40 miles. From the replies collected it is hoped to assemble average data which will be of great service in confuting the extravagant claims of gasoline-truck dealers regarding the operating and fixed costs of their service. Before the meeting closed it was announced that the Boston & Albany Railroad, the New York, New Haven & Hartford Railroad, the Boston & Maine Railroad and the Metropolitan Steamship Company have given consent to owners of electric trucks to drive their vehicles upon their wharves and terminal properties, gasoline vehicles being debarred on account of fire risk. Negotiations are in progress on behalf of the electric truck with several of the transatlantic steamship companies having docking facilities in Boston. Mr. Day Baker announced that a company has been organized in Boston by Mr. DeForest Smith, Tremont Building, to investigate the actual cost of vehicular transportation by the use of a speed-recording instrument which will deliver to the owner daily tape records of the exact performance of any vehicle in service.

Railway Electrical Engineers' Convention.

The third semi-annual convention of the Association of Railway Electrical Engineers was held on June 16 and 17 at the Union Terminal Station at Washington, D. C. Both the active and associate membership from all over the country were well represented, and a lively discussion on matters pertaining to standardization of electrical equipment on the railways was entered into. As all recommendations for standards are decided upon at the annual meeting held in Chicago each fall, no definite action was taken, but the various points were considered and discussed.

At the Friday morning session the sub-committee on lamps submitted a very comprehensive set of specifications for the purchase of lamps. Some objection was made to these by the representatives of the lamp manufacturers, but the general consensus of opinion was that the specifications as submitted were remarkably fair to all parties. The specifications proposed the inspection and testing of sample lamps by the purchaser's agent at the factory. Ten per cent of the lamps are to be examined, of which not more than 15 per cent shall fail to meet all requirements set forth in the contract. Of this 10 per cent, 2 per cent are to be used for a life test in the laboratory of the purchaser. The life of the lamp is the hours until the candle-power has fallen to 80 per cent of the initial value. The average candle-power shall be not less than 91 per cent of the initial candle-power. In event of failure of lamps to meet the required life test, the lot shall be returned to the manufacturer at his expense.

The Friday afternoon session opened with a discussion of the standards recommended by the committee on train lighting practice of the Master Car Builders' Association at the meeting of June, 1910. This report was reconsidered at the 1911 meeting of that association in Atlantic City, June 19-21.

Mr. D. J. Cartwright, electrical engineer of the Lehigh Valley Railroad, was instructed to submit certain suggestions and criticisms of the report at the Atlantic City meeting, the principal change being that a 150-amp fuse should be placed at each pole of the battery. Mr. C. R. Gilman, chief electrician of the Chicago, Milwaukee & St. Paul Railway, outlined the report of the committee on illumination, which will be presented in full at the annual meeting of the association in November. Mr. F. R. Frost, electrical engineer, Atchison, Topeka & Santa Fé Railway, presented the report of the committee on accounts and reports, outlining a report which would give a comprehensive detailed statement of the costs of the electric lighting of cars by various methods. The question of how much depreciation to allow on storage batteries—a large item in the maintenance charge—was discussed at length. The figure of 20 per cent per annum was suggested, but no final decision was reached. For the accurate comparison of car lighting costs on different roads it is essential that a standard form be adopted.

Saturday morning was devoted to a tour of the United States navy and gun shop, especial attention being paid to the electrical equipment used. Seventy-five members were in attendance at this meeting, which was one of the most successful in the history of the organization.

The Automatic Telephone System at San Francisco.

At the joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, May 24, Mr. S. G. McMeen, of the firm of McMeen & Miller, consulting telephone engineers, Chicago, presented a paper entitled "Notes on a Telephone System Recently Built in San Francisco and Its Neighborhood." Mr. McMeen has just returned from San Francisco, where under his direction there has been completed what is probably the most extensive automatic-telephone system in the world, serving a population of 600,000 in San Francisco and its suburbs, Oakland and Berkeley, across the bay. The switchboard features of this plant were described in a paper by Mr. Arthur Bessey Smith, read before the American Institute of Electrical Engineers' (Jefferson, N. H.) meeting, June 29, 1910, and abstracted in the *Electrical World* of July 7, 1910. Mr. McMeen's paper covered briefly the switchboard equipment features of the work, but related more particularly to matters of construction and to some of the difficulties encountered in installing a comprehensive telephone system following the almost complete destruction of a large business section by fire and seismic disturbances. The entire system comprises ten groups of automatic switching equipment, properly assembled under two exchanges. All underground construction in San Francisco is laid in bituminized-fiber and vitrified-clay conduit, using iron-pipe laterals and insulated drop wires. The conduits are laid four high, with the required width of ducts, regardless of the number. On account of the sandy character of the soil the conduits have been inclosed in concreted sheaths, which were found especially serviceable following washouts due to sewers and water pipes opening up. Under such conditions large holes were washed in the ground, but in every instance the conduit in its concreted sheath spanned the opening like a beam and suffered no damage. Over 2,500,000 duct-ft. of conduit are installed in San Francisco, leading into more than 1000 manholes, the latter being of the molded concrete type. In these manholes the cables are supported on grooved wooden blocks, carried by rods inserted in holes drilled in the concrete.

On account of the destruction of all underground records by fire the task of placing conduit in the streets of San Francisco was made especially difficult. Even where records existed, reference to them had to be given up and the streets themselves used for determining line locations by excavation

and trial. In one instance, for example, after making a number of efforts to place conduit under one of the important street crossings, it was necessary to sink shafts 20 ft. deep at either curb and drive a tunnel between these. Even then, the constructors suffered their own troubles with the sewers and other underground lines.

The main trunk cables to Oakland and Berkeley from the city of San Francisco have a total length of 8 miles, 3 miles of which is submarine. On account of the use of comparatively large conductor in the land sections, however, where No. 13 B. & S. copper was employed, the transmission distance has been reduced to the equivalent of 6½ miles of standard cable construction, so that transmission of the best quality is maintained between the parts of the system. Mr. McMeen described a manual private branch exchange switchboard installed in some of the local business houses in which, to be consistent with the secrecy secured by the automatic system, the operator's listening key is arranged to be cut off while conversation is taking place.

During the discussion of the paper, Mr. Lee Campbell, engineer of the Automatic Electric Company, Chicago, referred to the difficulties met in an engineering way in arranging for the interconnection for the two-wire San Francisco automatic exchanges with the three-wire Oakland and Berkeley exchanges. Special provision had also to be made for securing the rapid two-number service across the bay. Mr. Franklin H. Reed referred to the advantages of the automatic apartment-house switchboard which obviates the presence of an attendant to receive incoming and outgoing calls at odd hours. Mr. Arthur Bessey Smith spoke of the flexibility and adaptation with which the automatic telephone meets all traffic conditions. Others taking part in the discussion were Messrs. D. C. Tanner, E. H. Smythe, Albert Scheible and J. G. Wray.

At the next meeting of the Chicago Electrical Section, to be held Sept. 28, Mr. Samuel G. Neiler, of the firm of Pierce, Richardson & Neiler, Chicago, will present a paper on "The Electrical Equipment of the New Northwestern Railway Station at Chicago."

Automatic Telephony.

The Chicago Electric Club June 7 listened to Mr. W. Lee Campbell, general superintendent of the Automatic Electric Company, on the subject "Automatic Telephony."

In introduction he spoke at some length on the long years of development and adversity and adverse criticisms which automatic telephony went through before it became a commercial success. The first patents on automatic telephone apparatus were taken out twenty-five years ago, which is a very long time for the present age, when other inventions like the trolley car, the tungsten lamp, etc., have come into commercial success so rapidly from the time of their first announcement.

In 1891 Mr. Joseph Harris, a traveling salesman looking for novelties to show at the World's Fair in Chicago, discovered the Strowger Automatic Telephone Exchange and secured the patents. A company by that name was organized which led a precarious existence for ten years and finally was enlarged into the Automatic Electric Company. Mr. Campbell recalled some of the earlier automatic exchanges, including those at LaPorte, Ind., and Michigan City, Ind. The real turning point in the history of automatic telephony seemed to come in 1903, when about 20,000 automatic telephones were installed in different exchanges. So doubtful were investors that the contract for the equipment of the Grand Rapids exchange provided for a seven-year guarantee, under which the Automatic Electric Company was to pay the cost of all labor and material needed for the alterations and repairs made necessary to render the system and service acceptable to 90 per cent of the subscribers. This contract, he said, had cost the company less than $1,000 for the supply of repair parts, etc. The first common-battery automatic telephone exchange was installed in 1905 at South Bend, Ind. At Pontiac, Ill., three and one-half years ago, the first two-wire system was installed. All previous systems had employed two wires running to the telephone and a third ground wire at each subscriber's instrument. The largest automatic telephone exchange at the present time is in Los Angeles, Cal., where there are 41,000 subscribers. The next largest is at San Francisco, Oakland and Berkeley, where there are 25,000 subscribers. The exchange now being installed in Chicago has 20,000 subscribers divided among eight offices. Patent rights in most of the foreign countries have been disposed of.

Automatic telephony, he said, has been a success because it is popular with subscribers and investors. Subscribers like the automatic calling features, while investors like the operating features. Among the operating advantages in a city like Chicago are the absence of operators and the shortening of subscribers' lines from subscribers' instruments to the nearest exchange, due to the trunking features. In answer to a question as to private branch exchanges Mr. Campbell explained that these could either be semi-automatic with a private branch exchange operator, or the automatic feature could be carried clear through to each telephone on a private branch exchange.

Lightning Phenomena.

In a paper recently presented before the Franklin Institute Dr. C. P. Steinmetz said that lightning is one of the most important uninvestigated phenomena of electricity. In the early days, he said, lightning was explained as a discharge from the clouds. The clouds being positively and the ground negatively charged, a spark jumps from the clouds to the ground.

Speculations were made as to how the clouds became charged, and as then the only method of producing electricity was by friction, it was said it might be the friction of the vapor through the air, or the rain-drops through the air, or some other form of friction. That explanation used to appear satisfactory, but Dr. Steinmetz said that with our present knowledge of dielectric phenomena, it is not now satisfactory.

It was thought that lightning was the discharge from the cloud to the ground. That means that the electric field between the cloud and the ground must be beyond the breakdown strength of air. In a uniform field the breakdown strength of air is about 75,000 volts per inch, or nearly 1,000,000 volts per foot. Even if the cloud is only 1000 ft. above ground, this would require 1,000,000,000 volts. If there were an electrostatic field between the cloud and the ground of 1,000,000,000 volts extending over the whole area of the thunder cloud, this would represent such an immense amount of electric energy that it is inconceivable how any reasonable source of energy can produce it; how it can exist without having a destructive effect far beyond anything known of lightning. Furthermore, a uniform field cannot well exist between clouds and ground on account of the unevenness of the ground surface.

Another conception is of, not a uniform electrostatic field, but an ununiform field, like that of the discharge between points. With long striking distances between points the average gradient is about 170,000 volts per foot. This would require only 170,000,000 volts between a cloud 1000 ft. high and the ground. This would be more reasonable. It would not require such an unreasonably vast amount of stored electric energy. But we know that in such an ununiform field the spark is preceded by a brush discharge covering more than half the distance. Thus, lightning should be preceded by a brush reaching down from the cloud and up from the ground for several hundred feet. Now, such an enormous brush has never been observed, and is inconceivable; the brush discharges occasionally observed at points during storms are only a few inches long. Furthermore, a 300-ft. brush is inconceivable, because the resistance of the ground is not low enough to conduct the energy necessary to maintain such a brush discharge.

Furthermore, most of the lightning discharges are not between the cloud and the ground, but are internally in the clouds, frequently reaching the length of several miles. So

one sees that the explanation of the lightning as a spark discharge similar to the discharge of the friction machine appeared plausible in the early days, but with our present knowledge it is not tenable any more.

The lightning discharge cannot be considered as a simple electric rupture, in the same way that an overloaded beam may break mechanically, but as an equalization of internal stresses, about as a piece of hot glass that is rapidly chilled, and thereby full of internal compression and tension strains, may suddenly break all over, by the internal stresses. So, with our present knowledge, we must consider as the most probable explanation —although not certain by any means—that the lightning discharge is the phenomenon of the equalization of internal electric stresses in the cloud, and is analogous to the splintering or breaking of an unevenly stressed brittle material like glass.

The question then is, how do those uneven electrostatic stresses originate in the cloud, and how do they reach such values as to cause internal equalization by rupture? If there has been produced a very highly unequal distribution of voltage in the electrostatic field of the cloud, it is easy to see how a discharge can pass along miles of cloud, without such unreasonably great potential differences as would be required for a direct discharge across space, just as from a scratch in a poorly annealed glass plate cracks may run all over the plate, splintering it in all directions. Assume that the potential distribution in the cloud becomes very uneven. If then at some point the potential gradient becomes higher than the disruptive strength of air, at this point a local disruptive discharge occurs, perhaps only a few inches in length. This discharge equalizes the potential gradient within its path, and thereby increases the gradient at the end of the discharge. If this gradient is already fairly high, it rises beyond the disruptive strength of air, and thereby the discharge extends farther along the discharge path, but by the voltage equalization resulting therefrom, still further increases the potential gradient ahead of the discharge, and in this manner the equalizing discharge extends farther and farther, possibly for miles, side discharges issue from it or run into it, until finally cloud regions are reached where the initial potential gradient is very low and the discharge gradually tapers down.

But where does the initial voltage come from, and how does it become uneven?

It is not so difficult at least to make a preliminary estimate of the building up to very high and uneven voltage distribution in the clouds as soon as you have assumed some initial voltage. We do not know where the initial voltage comes from, but we must accept the fact that there is normally a voltage gradient in the air, a potential difference between different altitudes which may amount to 100 volts or more per foot. In the air 100 ft. above the ground there may be a potential difference against ground amounting to thousands of volts. If you bring a wire up to there you do not carry a current down, you merely carry the ground potential up, but by a carefully insulated electrostatic voltmeter you can measure these potential differences. Possibly this potential gradient in the atmosphere may even be of cosmic origin, the earth having a high negative potential against our solar system, against the universe, which would mean that there must be a positive voltage gradient from the surface of the ground into space.

If condensation takes place in the higher regions of the atmosphere, rain-drops form, minute drops at first, which necessarily must be at the potential of the air in which they form. That means they have a potential difference against the ground, and therefore an electrostatic charge against the ground corresponding to this potential difference. Assuming now that many of these minute rain-drops conglomerate to larger drops, it means, that many small condensers conglomerate to one condenser, which is somewhat larger in capacity than each component, but very much smaller in capacity than the sum of the capacities of its components. But it contains all the electrostatic charges of the rain-drops, and at the much smaller capacity the same charge gives a higher potential difference. Suppose 1000 small rain-drops conglomerate into one large one. This has ten times the capacity but 1000 times the charge, hence 100 times the voltage. Conglomeration of minute drops into larger ones thus must give a great increase of potential difference against ground.

The clouds are by no means uniform in density, and where the density is greatest conglomeration of condensed drops takes place to a much greater extent, building up to a much higher voltage, and thereby between the parts of the cloud of different density, the light and the dark portions, potential differences must appear and increase with increasing condensation, until somewhere the disruptive gradient is passed, equalization occurs by a lightning discharge, and then the same play repeats again and again.

Lightning discharges then are the result of the voltage unequalities produced in the clouds by the unequal rate of conglomeration of rain particles due to the unequal cloud density.

In agreement with this is the fact that heavy lightning strokes are usually followed by a heavy downpour of rain; in reality they are preceded and caused by it, but it takes time for the rain-drops to come down.

Let us assume now that the process is reversed, and after conglomerating to high voltages the rain-drops evaporate again. Since gases apparently do not carry electrostatic charges the rapidly dwindling rain-drop retains its entire charge, hence must rise in potential, and finally must discharge, and this progressive evaporation of the rain-drops must also result in the building up of potential differences and therefore the formation of lightning, and this may explain the two forms of lightning, that accompanying rainstorms and thunderstorms, and the so-called "heat" lightning.

The former is the result of condensation and conglomeration, the latter the result of evaporation of rain-drops.

One sees then that in this field, which is not merely of theoretical interest, but of high industrial and general importance, our knowledge is still very limited; it is a fairly unexplored field of electrical engineering and electrical science. It is a branch of electrostatics, of the phenomena of the dielectric field. The phenomena of the dielectric field we cannot very well call unexplored, because there has been a great deal of investigation in the early days, and volumes have been written on it. Many of us may still remember the early days when the textbooks of electrical engineering started with the theory of the distribution of the electric charge, investigated the electric density on an ellipsoid and all that sort of thing. All this has now pretty well vanished from electrical engineering textbooks. With the development of electrical engineering, electrostatics became of less interest and were thus neglected. Only in recent years, when we have in transformers and transmission lines reached voltages higher than in almost any electrostatic machine, and those not of a negligible power, but of a very large power, the field of electrostatics has become a very important one and has to be studied again.

It is seen that in the study of electrostatics the conceptions of the work of former days are untenable, from our present point of view; we cannot conceive of the dielectric phenomena as a charge on the conductor surface, we know there is not an electric charge on the conductor, the dielectric energy resides not on the conductor surface, but is in the space around the conductor, in the dielectric field, and the so-called "charge" is nothing but the termination at the conductor surface of the electrostatic field in space. It is the electrostatic or dielectric field which we must consider as representing the phenomena of electrostatics, in the same way as Faraday has shown us with the magnetic field.

The old conception of the electrostatic charge on the conductor has been the cause of the far greater difficulty which we find in dealing with even simple phenomena of electrostatics, compared with the simplicity with which even apparently complex phenomena are treated by the conception of the lines of magnetic force.

One must then abandon the conception of the theory of electrostatics of the early days—which still largely is used in theoretical textbooks—as incorrect and useless. Capacity then is not the capability of the conductor to store electric quantity, but is the ratio of the number of lines of dielectric force to

the emf which produces them, just as permanence is the ratio of the number of lines of magnetic force to the mmf which produces them, the "charging current" is no more a current charging the conductor with electricity than the "inductance voltage" is a voltage charging the conductor with magnetism; the former as "capacity current" supplies the energy stored in the dielectric field, just as the inductance voltage supplies the energy stored in the magnetic field, and dielectric and magnetic phenomena are very largely analogous and treated in the same manner and with the same simplicity.

This was not possible with the conception of electrostatic charges, and even simple problems, as the calculation of the capacity and the mutual capacity of parallel conductors, become so complicated that the most satisfactory method of their calculation was not to calculate the capacity at all, but calculate the corresponding inductance and derive the capacity by the relation, that capacity times inductance equals the square of the velocity of propagation, which in space is the velocity of light (3×10^{10}).

In conclusion Dr. Steinmetz said it will thus be seen that in this field, which is of the highest industrial importance now, where we have in transmission lines reached voltages which approach those of lightning, we are only just in the beginning of an intelligent understanding, an insight into the phenomena.

In reply to a question Dr. Steinmetz said that the lightning rod is a great protection, and that he would not like to be in an exposed place without such protection. But one must not expect that one rod on one end of the building will completely protect the other end a hundred or more feet away. There must be sufficient rods to extend their protective zone over the entire area; the apex of the roof, and other projecting edges, must be protected by connecting wires, etc. That is, like any other apparatus, the lightning rod protection must be installed intelligently and properly to be effective. The general principle is correct, but it must be rationally applied.

Engineering Instruction Coincident with Cultural Studies.

In a recent address in Chicago, Prof. William C. Bauer, who is in charge of the course in electrical engineering at Northwestern University, Evanston, Ill., detailed the aims of the new engineering school at that university. The Swift College of Engineering at Evanston is a handsome building on the shore of Lake Michigan, and the engineering department has been installed there for two years. Two courses are offered, one leading to the degree of C. E. at the end of the fifth year, the other in mechanical and electrical engineering and leading to the degree of E. E. at the end of the same period. For the first three years the courses are identical, specialization in more advanced subjects being introduced during the last two years.

The main idea at the university seems to be to carry on engineering instruction at the same time that cultural studies are also being given. Thus, for the first three years of the course the study of physics, languages and literature is the same both for the liberal arts students and the engineering students. Prof. Bauer emphasized the fact that talent, training and tact are necessary for the embryo engineer. He spoke of these qualifications as the three T's, and declared that the good engineer should be a man of liberal education as well as of technical education. The relation of pure and applied science may be expressed by an angle of lag, and it is the duty both of educators and practising engineers to make this angle as small as possible. The aim in college should be to teach the students the "why" of things as well as the "how."

One interesting feature of the work at the university is that engineering students are required to spend six weeks of each of the four summer vacations in some practical engineering work. The student makes a report of this work on his return to college in the fall, and is given credit for it. A practical insight into actual engineering performances may be obtained in this manner, and at the same time the experience helps the young man to acquire the desired tact. As yet the equipment at the Swift College of Engineering is not elaborate, but nearly all kinds of engineering plants are to be found in and near Chicago. The speaker made particular reference to the courtesy of Vice-president Baker, of the North Shore Electric Company, in permitting students to inspect the plants of that company.

In concluding, Professor Bauer made use of an analogy comparing men to various types of electric motors, and said that it was the hope of the engineering department of the university to turn out a few over-excited synchronous motors. Prof. J. F. Hayford, dean of the engineering school, and Prof. E. H. Freeman, of the Armour Institute of Technology, spoke briefly.

Corporation Tax Return Affected by Depreciation.

The Washington correspondent of the Chicago *Daily Tribune* says that the United States Treasury Department will probably make an inquiry to determine why the depreciation account of the Chicago Telephone Company was so much larger in 1910 than in 1909, reducing the apparent net income more than $800,000, and, therefore, making the corporation tax to be paid the government about $8,000 less than in the preceding year. In 1909 the Chicago Telephone Company reported a net income of $2,191,665. For the year 1910 the net income reported is $1,366,557. The falling off in net profit is, therefore, $825,108, although the company did about $1,300,000 more business in 1910 than in 1909. The difference is caused by the jump in the depreciation account, which in 1910 is placed at $2,347,068. This compares with $1,051,197 for depreciation in 1909, the increase being $1,296,871, which is considered remarkable by the Washington authorities. Mr. B. E. Sunny, president of the company, is reported as ready to welcome an investigation. He says that the increase in the depreciation charge is due to the company's efforts to comply with the recommendations made by official experts representing the city of Chicago. If the company's efforts to conform to these suggestions fail to satisfy the federal government, the company contends that it is not to blame.

Massachusetts Legislative News.

The question of extending the leases of the Boston Elevated Railway Company has raised a storm of discussion in the present legislative session, following the introduction of a bill in the Senate providing for the continued dominance of the company in local transportation affairs for the next fifty years. As introduced the bill provides for the construction of a tunnel to Dorchester from Park Street to Andrew Square by way of the South Station; for a Boylston Street subway in place of the Riverbank tube authorized a few years ago, and for extension of the East Boston tunnel into the outer West End district of Boston. A second part of the bill provides for the extension of the lease of the West End Street Railway Company to the Boston Elevated for fifty years from date at a rental of 7.5 per cent on the common stock of the West End company and at a rate of 8 per cent on the preferred stock. A third section of the bill provides for the expiration of the present and prospective subway leases in 1936, provision being made for their extension at the option of either the company or the city after 1936 for a maximum period of twenty-five years or a minimum period of such length that the rentals shall have paid the cost of the subways at the end of the period. Parts one and three, to become operative, require the consent of the Mayor and City Council, while part two needs the approval of a majority of the stockholders of the Elevated and West End companies. The West End interests own practically the entire surface-line system of Boston, although for about fourteen years the management of this branch of the service has been carried on by the Boston Elevated Railway Company under a lease. The railway company contends that it cannot afford to become responsible for many millions of dol-

lars to be invested in additional subways unless it can be assured of a control sufficiently long to remove the hazards naturally incurred by such large investments. Public sentiment in Boston appears somewhat disinclined to favor a fifty-year lease, although the demand for additional rapid-transit lines to be operated electrically is insistent. In a statement issued a few days ago the company points out that the essentials of its plans have been approved in the reports of the joint commission on Boston rapid transit, consisting of the Massachusetts Railroad and Boston Transit Commissions sitting together, in answering inquiries of the Legislature of 1909. An effort is being made to secure a comprehensive solution of the entire Boston rapid-transit problem by the present bill. The Boston Elevated Railway Company has assumed in recent years burdens in the way of rentals and charges on subway, elevated and tunnel lines amounting to over $100,000,000, and its management feels that in the face of the rising costs of operation and the limitations of the 5-cent fare unit as expressed in the company's charter, enormous additional expenditures cannot be shouldered unless a more permanent foothold is given to the interests now performing a service which is reputed to be the best of its kind in the world.

The outlook for the passage of a bill providing for steam-railroad electrification at Boston continues to grow more promising. The House has passed the bill without debate to be engrossed. The measure provides that all railroads of standard gage entering Boston shall be equipped for electrical operation within the limits of the metropolitan park district within such time and in such part and order as the Railroad Commission shall determine. Plans and specifications covering some substantial portion of the work are to be submitted to the commission for approval by September, 1912, after which the board is required to order in its discretion electrification with due regard to the resources of the company, proper economy in operation, public safety and convenience.

The bill providing that if the consumption of electricity exceeds $7 worth of energy in a year, no charge shall be made for the use of electric meters has been passed to be engrossed. The opposition to the bill arose chiefly from municipal plants, which contend that it is liable to injure their business to a serious degree. An effort to amend the bill to exempt municipal plants failed.

President C. S. Mellen, of the New York, New Haven & Hartford Railroad, appeared before the committee on railroads recently and stated that if the bill giving the New Haven interests authority to purchase the Boston, Revere Beach & Lynn narrow-gage railroad is passed, including the right to build a tunnel under Boston Harbor, electrification will take place at the earliest possible date.

New York Commission News.

The Public Service Commission, Second District, has closed on its records a complaint of certain residents of Hudson Street, South Glens Falls, against the United Gas, Electric Light & Fuel Company, which asked that a gas main be extended 1000 ft. to supply gas to complainants. At the hearing the commission directed that the extension be made provided eight residents would become customers and would guarantee the use of 1000 cu. ft. per month. The company agreed at that time to make the extension if eight customers were secured, but complainants have been unable to secure pledges from that number of people and the commission has directed a dismissal of the complaint.

The Orange & Rockland Electric Company has been authorized to execute a mortgage covering its rights, franchises and properties to secure the sum of $500,000 twenty-year 5 per cent bonds. The company is authorized to issue presently bonds to the amount of $183,500, $37,000 to be used to refund outstanding bonds, $97,000 to pay off and discharge obligations of the company incurred for capital purposes, $5,000 to discharge accounts payable incurred for capital purposes, $44,500 for improvements and extensions to the company's plant and system, which is located in Monroe. The company operates in Monroe, Chester, Blooming Grove, Woodbury Falls, Florida, Washingtonville, Central Valley, Highland Mills, Turner and Oxford Depot.

This week adjourned meetings will be held at New York on the complaints of various municipalities in Westchester County against the Westchester Lighting Company for prices charged for gas and electricity in those communities; also on the application of the Northern Westchester Lighting Company at Ossining for permission to exercise franchises for the service of gas and electricity in the village of Pleasantville, Westchester County.

Ohio Public Service Commission.

The Ohio public utilities bill became a law last Wednesday night without Governor Harmon's signature. It is said that he was unwilling to affix his approval to the section allowing the consolidation of telephone companies with such capitalization and rates as the Public Service Commission may fix and at the same time he did not wish to take the responsibility of vetoing the section, so he allowed it to become a law by the expiration of the period fixed by law.

The law will become operative on June 30, after which all public service corporations will be subject to the regulation of the State Railroad Commission, under the name of the Public Service Commission of Ohio, with the exception of local utilities, over which the commission can exercise no power unless an appeal is taken to it.

The provisions of the bill were given in a recent issue. The commission will employ inspectors, examiners and such other help as is necessary to do the work required by the new law, and a complete organization will be effected as soon as possible. Members of the commission and chiefs of departments are now studying the systems used in other states and will endeavor to profit by them rather than work out a system of their own by experience.

New Hampshire Commission News.

Governor Bass has nominated and his council has unanimously confirmed as members of the Public Service Commission Messrs. Edward C. Niles, of Concord; John E. Benton, of Keene, and Prof. Thomas W. D. Worthen, of Hanover. The new commission law provided that it should become effective June 1, replacing the Railroad Commission, which was abolished on that date; but a deadlock occurred between the Governor and Council, the latter refusing to confirm the names of the men nominated by the Governor.

Governor Bass was desirious of having on the commission Mr. R. B. Stevens, who, as a representative in the last Legislature, took an active part in passing the law creating the commission, but the Council would not confirm any list of nominations containing the name of Mr. Stevens, so that the Governor was forced to offer another name, that of Professor Worthen. The law, which has been in nominal effect since June 1, thus now goes into actual operation.

Mr. Niles and Mr. Benton are prominent lawyers, and Professor Worthen is head of the department of mathematics at Dartmouth College.

Maryland Commission News.

The Maryland Public Service Commission last week heard argument on the petition of the Chesapeake & Potomac Telephone Company for permission to purchase the stock of the Western Maryland Telephone Company, which operates in Allegany County, which action is opposed by the independent telephone interests on the ground that it will cripple the service of the companies that now compete with the Chesapeake &

Potomac and which exchange business with the Western Maryland. The latter company has its headquarters in Cumberland and has been paying small dividends. The Chesapeake & Potomac proposes to buy all the stock at a price in advance of what it has been bringing on the market and to assume the bonded indebtedness, part of the payment to be made in stock of the American Telephone & Telegraph Company.

The city authorities have announced that unless the Consolidated Gas, Electric Light & Power Company, of Baltimore, decides to reduce its rates for gas and electricity by July 15, the city will make application to the Public Service Commission for a thorough investigation of the company's business. It is understood that the city officials have in mind a reduction in gas rates from 90 cents per thousand cu. ft. to at least 85 and perhaps 80 cents, and a general revision of electrical rates for industrial use. Under the law the commission could initiate proceedings, but it is thought that a formal application from the city would be more appropriate. For more than a year past the city, though employing experts for the purpose, has accomplished nothing in the way of bringing the case to a head.

That the Public Service Commission has power to force the Brooklyn & Curtis Bay Light & Water Company to extend its service to Brooklyn, in satisfaction of a complaint from the Brooklyn Improvement Association, is the opinion of Mr. W. Cabell Bruce, counsel for the commission. Mr. Bruce declares that the justice of exercising such power will depend entirely upon the evidence presented at the hearing before the commission. The Brooklyn Improvement Association appealed to the commission through J. Oliver Johnson to force the light and water company to extend its service to its town, and presented evidence to show that the stipulations laid down by the company as necessary to the extension had been complied with. In a communication from the chief engineer of the company the association was promised the service provided that it could furnish 200 subscribers. The reply was that 212 could be furnished at once, but the company's lines were not extended and no intimation was given that they were to be. The association requested the commission to take the matter up and force the company to furnish the service as required under its charter.

Wisconsin Commission News.

The commission has refused the application of the Red Cedar Valley Electric Company for authority to increase rates, but has ordered or suggested amendments to the present schedule which will eliminate certain of its objectionable features. The company owns and operates a hydroelectric plant at Rice Lake, Wis. It alleged in its complaint that the present rate schedule is not adjusted to the costs for the different classes of service; also, that the revenue derived from the business does not provide for a depreciation fund and a fair return upon the investment. A detailed investigation of the company's financial affairs showed that the present rate of return amounts to between 6 per cent and 7 per cent on the investment, after allowing for depreciation. Furthermore, the company has ample power and generating capacity for a considerable increase in station load, which means that additional business could be taken on without increasing the fixed charges materially. These facts led the commission to the conclusion that an increase in rates would not be justifiable. The investigation did show, however, that the present rates were not adjusted to the costs. The table of unit costs deduced by the commission is as follows:

Use of Active Connected Load. Hours.	Capacity Charge. Cents.	Output Charge. Cents.	Total Cents.
1	11.03	2.19	13.22
2	5.52	2.19	7.71
3	3.68	2.19	5.87
5	2.21	2.19	4.39

An analysis of the consumer data showed that about 50 per cent of the lighting consumers had small installations of from five to ten lamps each. The small-residence consumer used his active connected load on an average 2.3 hours daily, while the business consumer used his active load on an average 3.1 hours daily. These consumers, therefore, are entitled to a lower rate than 8 cents, which is the present rate for all consumers, irrespective of size. On the other hand, consumers whose installations exceeded twenty lamps seldom used their active load more than a fraction of an hour daily. These consumers cost the company in the neighborhood of 18 cents per kw-hour. With a view of eliminating these inequalities the commission suggested the following schedule for commercial lighting: First thirty hours' use per month of the active connected load, 13 cents per kw-hour; next sixty hours, 7 cents; excess, 4 cents. For residence consumers, 40 per cent of the connected load can be considered active; for business consumers, 65 per cent.

At the time of the hearing the company had in effect a uniform power rate of 5 cents per kw-hour, with a discount of 5 per cent for prompt payment. The commission ordered the company to amend this rate schedule and to substitute a fixed charge of $1 per month per horse-power for motors of from 1 hp to 5 hp capacity and 80 cents per month per horse-power for motors of over 5 hp, plus a meter rate of 2 cents per kw-hour for energy used. A minimum bill of $1 per month is allowed.

In the petition of Otto Schicker, of Janesville, against the Rockford & Interurban Electric Railway Company, the commission has ordered that the company discontinue its present rate of 10 cents for passenger fare from points within the city limits of Janesville to points about the yards of the Chicago & Northwestern Company in South Janesville, and substitute a 5-cent fare. South Janesville is about 80 rods outside the city limits. The present arrangement of fare zones, the petitioner alleges, works a hardship on the 200 or more railroad men whose business takes them to South Janesville. Outside of an early morning train on the Northwestern Railroad the Interurban offers the only means of transportation. An analysis of the fare zones showed that if the zone in controversy was extended so as to include South Janesville it would be no longer than the average of the company's present fare zones. An analysis of the company's earnings in Wisconsin revealed the fact that the present earnings amount to 10 per cent or more on the investment after deducting taxes and depreciation. The loss in revenue occasioned by the 5-cent fare will result in a decrease in total earnings of about one-tenth of 1 per cent.

The commission has authorized the Badger Railway & Lighting Company to issue 2550 shares of common stock of the par value of $100 each. Stock of par value $216,000 is to be issued and exchanged for the right-of-way and the grading on which the company proposes to construct its line of electric railway between the city of Whitewater and the city of Lake Geneva, a distance of about 22 miles. The order describes and put a value upon each piece of property which it will be necessary for the company to obtain. Stock of par value $39,000 is to be sold for money only and for not less than par. This money is to be used in paying the expenses of construction. All details relating to the exchange of property for stock must be filed with the commission within thirty days after the exchange.

The commission has served notice upon the Madison Gas & Electric Company that it is about to investigate the reasonableness of the company's rates, rules and regulations. This action follows an investigation which the commission has caused to be made and which indicates that the company's present rates may be reduced. This question was investigated by the commission about a year ago and a new rate schedule ordered which decreased very materially the rates in effect at that time. As this was the first large rate case to be decided by the commission, the action taken at that time was very conservative and the rates were not reduced to the extent which circumstances seemed to warrant. The increase in business during the past year, brought about largely by the reduction in rates, together with the liberality of the commission in fixing the present rate schedule, is enabling the company to earn 10 per cent or more upon its investment, according to the investigation just completed. The time for the hearing has not been set.

The commission is in receipt of a petition, signed by certain residents of the city of Milwaukee, requesting an investigation of the charges and rates of the Milwaukee Gas Light Company, with a view to fixing more reasonable rates. The petition alleged that the rates, rules and regulations of the respondent company are excessive, unreasonable and discriminatory.

CURRENT NEWS AND NOTES.

California Electrical Contractors.—The electrical contractors of California have arranged to charter a steamer for thirty days to cover their convention at Santa Catalina Island during July. Mr. John Rendler, Los Angeles, is in charge of the entertainment features.

Meeting of Electric Vehicle Association of America.—At the next meeting of the Electric Vehicle Association of America in the Engineering Societies Building, New York, June 27, Mr. W. P. Kennedy will present a paper entitled "Administrative Engineering and Salesmanship in the Commercial Car Field."

No Connecticut Public Utility Legislation.—The Connecticut Legislature has failed to pass any of the several public utility bills before it. The Senate passed one bill and the House another, but one would not accept the bill of the other. The bill passed by the House is less strong than the Senate bill, though the latter is not as rigorous as measures adopted in other states.

Heat Transmission Data.—While the laws governing the transmission of heat through various surfaces are not well determined and much experimental work is required to enable the engineer to make exact computations, Prof. J. R. Allen, of the University of Michigan, pointed out in a paper before the National District Heating Association at Pittsburgh June 7 that some reliable German data on the subject are published in an English translation, "Formulas and Tables for Heating," by Mr. J. H. Kinealy.

Institute of Operating Engineers Incorporated.—The Institute of Operating Engineers, with headquarters in the Engineering Societies Building, New York, has been incorporated under the laws of New York. The institute has a charter membership of 326, and the following branches: First district, New York branch; second district, Isherwood branch; fifth district, T. J. Waters branch; ninth district, Col. Goethals branch. There are branches yet unnamed in Providence, R. I., and Binghamton, N. Y., and fifteen others are in process of formation.

Diversion of Niagara Water.—An extension for two years, or until June 29, 1913, of the present regulations under the Burton law governing the diversion of water from Niagara River for commercial power has been recommended by the United States Senate committee on foreign relations, which reported favorably a resolution having this effect on June 16. Senator Burton explained that the existing treaty with Canada, under which the diversion of water on both the United States and Canadian sides is limited, would expire in another ten years, and it is proposed to continue the present status quo for that time.

Extension of German Transatlantic Cables.—The laying of the cable between Germany and Vigo, in Spain, in 1896, was Germany's first step to become independent of English cables. At its opening the intention was announced of extending the cable to the Azores and America. This was not fulfilled, as it was found that the Vigo cable was too overcrowded to serve as part of the American cable. An additional cable was therefore laid between Germany and America, touching only the Azores. The company recently made the statement that this American cable is so occupied that it has been decided to lay a second line. In all probability the Vigo cable will also be doubled in the next few months.

New Officers of Chicago Section, I. E. S.—At the meeting of the Chicago Section of the Illuminating Engineering Society on June 15 the following officers were elected for the ensuing year: Chairman, Mr. R. F. Schuchardt, electrical engineer, Commonwealth Edison Company; secretary, Mr. A. L. Eustice, illuminating engineer, Nernst Lamp Company; managers, Mr. Charles A. Luther, illuminating engineer, People's Gas Light & Coke Company, and Mr. A. J. Morgan, secretary National X-Ray Reflector Company. In the absence of the other elected officers brief speeches of acceptance were made by Messrs. Eustice and Morgan, and Mr. F. J. Pearson, the retiring chairman, thanked the section for the co-operation accorded the administration whose term was just closing.

Electricity in St. Louis Public Library.—New York is not the only city with a new and monumental public library building, for in St. Louis the Central Building of the St. Louis Public Library, which is a handsome and dignified structure costing about $1,000,000, is approaching completion. A liberal use of electricity will be made in this building. There will be thirty-one electric motors used to operate passenger elevators, dumb-waiters, book lifts, fans, vacuum cleaners, air-washing equipment, air compressors, boiler stokers and ash hoists. The lighting arrangements have been carefully designed and about 3800 incandescent electric lamps will be installed. The vestibule of the building will be illuminated by indirect lighting, the sources of light being concealed by marble cornices. The indirect system will be used almost exclusively also on the ground floor and the second story. Fourteen handsome lamp standards of bronze will be placed on the terraces surrounding the building. These and the interior lighting fixtures will be of special design, harmonizing with the general scheme of architectural treatment.

Edison Giant Roll Patents Sustained.—Two patents of Mr. Thomas A. Edison on crushing machinery have been strongly sustained in a recent decision by Judge Hazel in the United States Circuit Court of the Western District of New York. These rolls are referred to as follows in the recent book "Edison: His Life and Inventions," by Messrs. Frank L. Dyer and T. Commerford Martin: "No such departure was as radical as that of the method of crushing the ore. Existing machinery for this purpose had been designed on the basis of mining methods then in vogue, by which the rock was thoroughly shattered by means of high explosives and reduced to pieces of 100 lb. or less. These pieces were then crushed by power directly applied. If a concentrating mill, planned to treat 5000 tons or 6000 tons per day, were to be operated on this basis the investment in crushers and the supply of power would be enormous, to say nothing of the risk of frequent breakdowns by reason of multiplicity of machinery and parts. From a consideration of these facts, and with his usual tendency to upset traditional observations, Mr. Edison conceived the bold idea of constructing gigantic rolls which, by the force of momentum, would be capable of crushing individual rocks of vastly greater size than ever before attempted. He proposed to eliminate the slow and expensive method of breaking large boulders manually and to substitute therefor momentum and kinetic energy applied through the medium of massive machinery which in a few seconds would break into small pieces a rock as big as an ordinary cottage piano and weighing as much as 6 tons. Engineers to whom Mr. Edison communicated his ideas were unanimous in declaring the thing an impossibility; that it was like driving two express trains into each other at full speed to crack a great rock placed between them; that no practical machinery could be built to stand the terrific impact and strains. Edison's convictions were strong, however, and he persisted."

Electric Club of Chicago.—Mr. Sidney A. Teller, in charge of West Side Park No. 2, addressed the Electric Club of Chicago on June 14 on the subject of "Chicago's Small Parks and What They Are Doing for the City." Mr. Teller's remarks were most interesting and instructive and gave his hearers a new idea of what modern "social engineers" are doing for the welfare of the inhabitants of crowded cities.

Chicago Has 250,000 Telephones.—The Chicago Telephone Company has passed the quarter-million mark in the number of telephones in service in the city of Chicago. This is about one telephone for every nine inhabitants. Chicago has more telephones than any other city in the world except New York, and more in proportion to population than New York. It has twice as many as London and five times as many as Paris.

Long Electric Railway for Cuba.—It is reported from Havana that the President of the Cuban Republic has signed a bill granting a concession to Mr. Hugh. Reilly to build and operate an electric railway to be known as the Cienfuegos, Palmira & Cruces. The project is said to provide for a line about 300 miles long, paralleling other roads at various points. Water-power for the operation of the railway is to be developed at a point about 30 miles from Cienfuegos, according to the account.

Rates for Electricity in Los Angeles.—The City Council of Los Angeles has been asked by the Vermont Square Improvement Association to take the first step toward the abolition of the Board of Public Utilities and restoration to the City Council of the power to fix rates for electricity. The association asks that the existing rates be continued for another year. In similar vein the Arlington Home Improvement Association has asked the City Council to "abolish all 'bureaus,' 'scientific expert' heads and 'commissions' having legislative power, and place the same back in the Council, where it belongs."

Larger Appropriation for University of Illinois.—Governor Deneen of Illinois has signed bills appropriating $3,500,000 by the State for the University of Illinois to cover a period of two years. The Governor also approved the Hamilton "one-mill" bill, which in the future will provide an annual revenue of about $2,000,000 for the university. The generous attitude of the State authorities will establish the State university upon an entirely new financial basis and will relieve the president and trustees from the constantly recurring necessity of begging money from the Legislature. Part of the recent appropriation will be expended for a new engineering building at Urbana.

Gas Controversy in Chicago.—The People's Gas Light & Coke Company, of Chicago, still refuses to turn over to the city of Chicago the papers by which Mr. W. J. Hagenah, the city's expert under the preceding administration, arrived at the conclusion that the price of gas could be reduced from 85 cents to 77 cents. The documents are wanted for the use of Mr. E. W. Bemis, the expert of the present administration, who has been retained to see if a 70-cent rate cannot be figured out. The company dislikes the prospect of 70-cent gas even more than the proposed 77-cent rate, against which it made a protest. Therefore, it refuses to give up the papers which it placed at Mr. Hagenah's disposal. In reprisal the city threatens to withhold permits for street openings for gas-pipe extensions.

New Power-Transmission Project in Southern California.—It is reported in San Bernardino, Cal., that a new power-transmission company with ample financial backing is to enter the Southern California field in competition with the Southern California Edison Company and the Pacific Light & Power Company. Application has been made on behalf of the new company for a franchise to erect pole lines along highways in San Bernardino County. The supervisors of that county will advertise for bids on the application, and the bids will be opened on July 24. It is said that electrical energy will be obtained from water-power utilized on Bishop Creek, Inyo County, Cal., and also from the Los Angeles aqueduct now in course of construction. The new company intends to push its lines into new territory, including the San Jacinto Valley, where electricity is not available now.

Meeting New York Companies' Section, N. E. L. A.—The regular monthly meeting of the New York Companies' Section of the N. E. L. A. was held in the Edison Auditorium, New York City, June 19. Four papers were presented, two of which were read in abstract. The subjects were as follows: *Securing Business on the Instalment Plan: Its Advantages and Disadvantages,* by Mr. A. A. Pope; *Value of the Electric Sign as a Business Getter,* by Mr. Jesse Richards; *Value of the Show Window as an Advertising Factor,* by Mr. Joseph F. Becker, and *How Best to School Our Commercial Men,* by Mr. F. C. Henderschott. Mr. Pope's paper was read in his absence by Mr. E. A. Mills. Vice-chairman J. F. Becker presided and at the business meeting preceding the reading of the papers it was decided to hold an outing during the summer either on the Hudson or Long Island Sound. The membership of the New York Companies' Section is now 1539. The usual vaudeville entertainment was given at the end of the meeting.

Mexico A. I. E. E. Dinner.—On Friday evening, June 9, about thirty members of the Mexico Section of the American Institute of Electrical Engineers met at dinner in the famous Hotel Iturbide, City of Mexico. The chairman for the occasion, Mr. W. B. Hale, in opening the meeting at the conclusion of the repast, referred in a humorous vein to the prevailing political conditions in Mexico, with its "provisional" President and cabinet, and said that it appeared to be in keeping with the general order of things that the Mexico Section should have a provisional chairman—the one who had the honor of presiding at that meeting. An interesting paper by Mr. E. Loenarz, the chairman of the section, who was unavoidably absent, was then read. It was entitled "Tariffs for Electric Energy," and compared in an able manner the various systems of charging for electric light and power, such as flat rate, meter rate, combined "readiness-to-serve" and meter rate, etc., pointing out the proper application of each to conditions encountered in Mexico. An extended discussion, participated in by many of those present, followed the reading of the paper. It was announced that Mr. Leonarz would be the section delegate to the annual convention at Chicago, and that a meeting would be called in July for the election of officers.

Robinson Plan for Chicago Subways.—Before the local transportation committee of the Chicago City Council, on June 14, Mr. A. S. Robinson, at present chief engineer of the Mountain, Valley & Plains Railroad Company, of Dalhart, Tex., presented suggestions for a plan of Chicago subways involving a number of through routes between the North, South and West Sides of the city, besides several loops entering the downtown district from the West Side. Intersecting all of these subways, along the lines of Monroe Street and Jackson Boulevard, Mr. Robinson has provided a low-level transfer-belt subway by changing to which passengers may cross over to any other main line and continue their journeys, with universal transfers if desired. The subway tracks for the surface cars would be carried at a level of 16 ft. below the street surface and the elevated cars 14 ft. below the surface, requiring excavation averaging 20 ft. deep, or about 6 ft. below the Lake Michigan datum line. Automatic electric pumps would provide for removing any seepage coming through the waterproofed concrete walls. At the side of the tracks Mr. Robinson allows space for gas, water, electric-service and telephone wires, while in the 5-ft. earthen back-fill above the roof of the tunnel would be space for various small service laterals. The cost of four-track construction is estimated at $3,141,000 a mile.

Tests of Meters.—Of 7558 tests of electric meters reported to the New York Public Service Commission, Second District, in April, 1911, 412, or 5.45 per cent, were fast; 6046, or 79.99 per cent, were accurate, and 1100, or 14.56 per cent, were slow.

Marine Wireless Service Mandatory.—According to a bill passed by Congress, after July 1 ocean-going vessels carrying more than fifty passengers will be liable to a fine of $5,000 unless they are equipped with wireless-telegraph apparatus capable of transmitting messages not less than 100 miles and manned by an operator carrying a certificate issued by this or another government.

Susquehanna Power at Baltimore.—The United Railways & Electric Company, of Baltimore, expects the company's cars to be operated by Susquehanna power sometime before Sept. 1. The high-tension current brought from the power plant will be transformed or reduced at the transformer station of the Pennsylvania Water & Power Company, Eighth Street and Philadelphia Road, whence it will be brought to the Pratt Street power house of the United Railways for distribution over the system. The power house of the United will be run every afternoon from 1 o'clock until 7 o'clock, so as to take care of the rush-hour service and period of heavy traffic.

Some Federal Tax Figures.—A Chicago newspaper publishes the returns of a number of large Chicago corporations for 1910 under the federal corporation-tax law. The Commonwealth Edison Company reports a net income for the calendar year 1910 of $2,849,712, compared with $2,303,786 in 1909. The federal tax for 1910 to be paid by this company is $28,447. The increase in net income for 1910 was $545,926. It is interesting to note that, although the People's Gas Light & Coke Company of Chicago reports a larger net income for 1910 than the Commonwealth Edison Company, the increase is much less. The gas company's net income for 1910 was $3,332,465, an increase of but $114,562 compared with the preceding year.

Progress on Keokuk Dam.—Bulletin No. 2, just issued by the Mississippi River Power Company, which is constructing the 200,000-hp water-power dam and power house in the Mississippi River opposite Keokuk, Ia., shows the progress of the work for May. Cofferdams have been constructed bearing the site of the power house and dam in the riverbed, and the construction buildings, crushers, mixers, power house, etc., are completed. Footings for the dam have been prepared and traveler cranes are already in position placing concrete. Work is being carried on simultaneously on both sides of the river, which is nearly a mile wide at this point, and all parts of the work are interconnected for communication by a private telephone system having seventy instruments.

Electric Roses for the Coronation.—One of the features of the night spectacles during the medieval coronation function in London this week is the extensive use of shades for incandescent lamps having the appearance of "Tudor" roses, the botanical name of this species of rose not being divulged. It is reported that one firm alone has done 1,000,000 ft. of wiring to supply 750,000 Tudor make-believe roses. A large number of clubs, banks and commercial houses have placed orders for electric roses and a group of clubs in the West End have combined in one order for 10,000 roses to be arranged in one scheme of decoration. The Bank of England will have 5000 electric lamps placed so as to outline the structure at night and 2000 lamps will decorate the American Embassy.

Report on Philadelphia Street Railway Service.—The report of Messrs. Ford, Bacon & Davis, of New York, in reference to the service and equipment of the Philadelphia Rapid Transit Company, rendered to the Pennsylvania State Railroad Commission, has been issued in book form. It is an analytical engineering study of the conditions affecting the physical operation and rolling stock of the Philadelphia system. Chapter I contains a brief summary of the report and the many detailed studies of different features of operation. The detailed report is divided into the following general subjects: Physical property as of June 30, 1910, surface cars, sub-elevated cars, recommendations as to cars, operating statistics 1907-10, comparative operating statistics of large American street railway systems, car maintenance, accidents, traffic and service, rush-hour problem and routing. Volume II contains tabulated statements, maps and diagrams relating to the general subjects of the report.

Another Selden Patent?—The text of a decision rendered several months ago by the Court of Appeals of the District of Columbia indicates that there is another Selden patent on the stocks. In the present case the regular application was filed in 1879, that in issue being a division made in 1895. After various routine proceedings the claims of the application were rejected, whereupon twenty-one other claims were submitted in lieu of those passed upon. In 1902 the applicant filed a substitute specification containing thirty claims, including the above-mentioned twenty-one claims in amended form. In July, 1904, an amendment was presented erasing certain claims and changing certain others, and in September of the same year a further amendment was filed canceling all of the claims and presenting twenty-four others. In 1907 three other amendments were filed, whereupon certain suggestions were made by the examiner which were not complied with until 1909, or thirty years after the date of the original application. After consideration of a communication received soon after from the examiner, the commissioner of patents decided that owing to the lack of action in 1902 and 1904 the application must be held as abandoned for lack of sufficient prosecution. The court reversed this decision of the commissioner and ordered the application to be reinstated. The opinion of the court gives no clew to the subject matter of the specification and claims.

The Gyro-Compass.—An interesting application of the gyroscope to the construction of a compass is being shown in London. The apparatus, which is known as the Anschütz gyro-compass, possesses the advantage that it points to the true north, thereby greatly simplifying the use of charts in navigation, and it is also unaffected by the presence of steel. It depends on the principle enunciated by Foucault, that a gyrostat with only two degrees of freedom will at any point on the earth's surface, except the poles, tend to set itself with its axis of rotation parallel to the axis of the earth by reason of the relative rotations of the two bodies. As applied to the ship's compass the gyrostat is suspended below the card with its axle fixed directly under the north and south line, from a circular hollow ring floating in a bowl of mercury, which is carried on gimbals in the usual way. It is driven by a small three-phase motor whose rotor is rigidly fixed in the inside of the gyrostat flywheel. The speed of rotation is approximately 20,000 r.p.m., and the driving energy furnished by a small motor-generator set has a frequency of 333 cycles. The oscillations of the gyrostat's axle and therefore of the compass card are damped by means of the air blast from the flywheel. An electrical transmitting arrangement can be fitted by which the movements of the needle in relation to the ship can be reproduced on receivers in any part of the vessel. The master gyro-compass can thus be placed in any desirable and well-protected position low down within the hull. An inner card in the receivers makes a complete revolution for 10 deg. alteration of course, and by rendering small variations readily perceptible tends to increase closeness in steering. It is calculated that the directive force of the gyro-compass is approximately fifteen times greater than that of a good magnetic liquid compass placed in a position where it is free from disturbances by surrounding iron.

WATERPOWER FROM CANNON FALLS.

Second Hydroelectric Development of the Consumers' Power Company in Southern Minnesota.

AS outlined in an article on the Blue Earth water-power development near Mankato, Minn., in the *Electrical World* of April 13, 1911, energy for the transmission and distribution system of the Consumers' Power Company in the southern portion of the State is obtained by water-power plants at the Cannon Falls and Blue Earth sites. These plants, 80 miles apart, serve the rich intermediate region, including the cities of Mankato, Northfield, Faribault and Cannon Falls, the first three having auxiliary steam-power plants in connection with their transforming substations. The transmission line from Cannon Falls through Northfield has now been completed to Faribault.

The Cannon Falls plant develops a maximum hydraulic head of 59 ft. in the Cannon River, 2 miles west of the village of Cannon Falls. The dam is of the Ambursen hollow reinforced-concrete type, and comprises forty-three 18-ft. bays, making in all a length of nearly 800 ft. of concrete construction. The plan of the structure is roughly that of an expanded Z, comprising a central north-and-south section 400 ft. in length, including the 100-ft. power house; a southern wing wall 350 ft. in length, making an angle of 40 deg. with the power-house section, and a 100-ft. north wall roughly parallel with the south wing wall.

The buttresses supporting the sloping upstream deck of the dam are 28 in. thick at the bottom, where the largest central ones have up and down stream bases 90 ft. in length, and taper to 12 in. in thickness at their tops. The 45-deg. sloping deck is 36 in. thick at its lower edge, tapering to a thickness of 14 in. at the top. The weight of the impounded water over this sloping upstream deck presses downward on its surface and increases the stability of the dam, thereby equalizing any tendency to overturning or horizontal sliding due to the horizontal pressure of the water.

The ordinary 58-ft. operating head created by the dam impounds a pond of about 1800 acres extending five miles upstream. About 18,000 acre-ft. of water can thus be drawn upon by lowering the pond level within 10 ft. below the full reservoir level. The turbine units installed are designed to operate efficiently throughout this range, with a minimum head of 49 ft.

The spillway section of the dam extends from the power-house wall southward 414 ft. and along the south wing section of the dam. The spillway crest is at an elevation 55.5 ft. above tailwater, and to this head 30 in. additional can be added by the erection of flashboards supported on pins in sockets provided for them along the spillway crest. The side walls, which lock into the earth embankment, are 62 ft. above tailwater level, and all embankments are 2 ft. higher than this level. Beneath the reverse-curved apron of the spillway section nearest the power house are the four 7 x 5-ft. sluice gates for controlling the flow of water through the dam. With these gates and with its 414-ft. spillway the dam is capable of passing extreme floods of 15,000 cu. ft. per second.

Altogether the completed dam contains 16,500 cu. yd. of reinforced concrete, using 23,500 barrels of cement and 350 tons of steel reinforcing. In preparing the site for the dam 21,500 cu. yd. of rock were excavated, besides 17,000 cu. yd. of earth. The total embankments and fill aggregate 17,000 cu. yd. Along the north side of the impounding basin and about 3500 ft. from the dam it was necessary to erect a dike 2000 ft. long, with a concrete core wall carried 10 ft. below the level of the ground. This dike required 12,000 cu. yd. of earth. Its water slope is

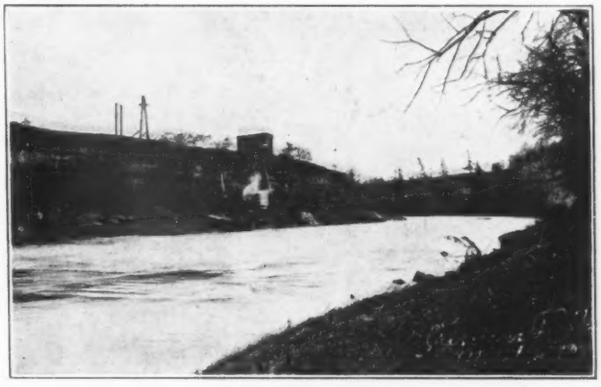


Fig. 2—View of Cannon Falls Dam Site Before the Beginning of Construction Work.

paved with 3000 cu. yd. of quarry waste and 2500 cu. yd. of hand-laid riprap.

An incident in the early construction of the Cannon Falls dam was the change in location to a point about 100 ft. upstream from the original site which had been partially prepared for the structure. This summary action was taken as a refusal to submit to what were felt to be extortionate demands after the arrangements for the original site in question were thought to be fully agreed upon with the owner. Such annoying incidents frequently beset those engaged in developing public enterprises, but in this case the rebuke was administered promptly by moving the dam and redesigning the plans for the new site. Work at this position was begun in April, 1910, and by March 1, 1911, the waterwheels were ready to operate.

The power house is a poured-concrete structure, measuring 54 by 92 ft. in plan and 33 ft. from the generator-room floor to the roof. Rising 16 ft. above the main roof level is the high-tension gallery. The completed plans call for a head-gate house 12 ft. above the bulkhead level from which the gate wheels are manipulated.

Entering through the inclined trash racks and head-gates the water for the main turbine units is led through 60-in. steel penstocks to the twin Pelton-Francis spiral-case center-discharge waterwheels, each having a rating of 750 hp. Each pair of wheels drives a 550-kw, 2300-volt, 60-cycle, three-phase General Electric alternator at 300 r.p.m. To assist regulation of the machines a 12,000-lb. flywheel is mounted on the shaft between each pair of water turbines and the generator it drives. Directly connected on the shaft of each machine is also a 14-kw direct-current exciter-generator.

Two main waterwheel sets have already been installed, but provision is made for two additional similar units. The present separate waterwheel-driven 35-kw exciter set will also be duplicated. The water to operate the 60-hp waterwheel of this exciter is conducted to the runner through a 20-in. pipe slung

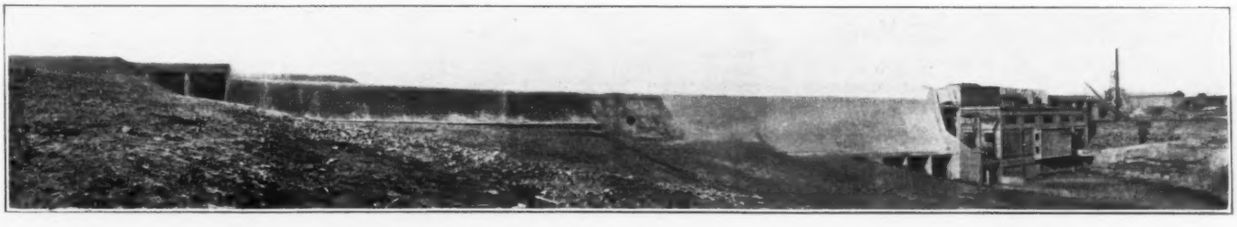


Fig. 1—Panoramic View of Cannon Falls Dam and Power House Under Construction.

from the floor of the power house. A 15-ton hand-operated Whiting crane runs on overhead tracks the entire length of the power-house interior. For the switchboard gallery a bay window overhanging the power-house wall proper has been provided as in the case of the Blue Earth structure. From the 12-panel black-slate switchboard on the main generator floor level the 2300-volt oil switches on the floor above are operated

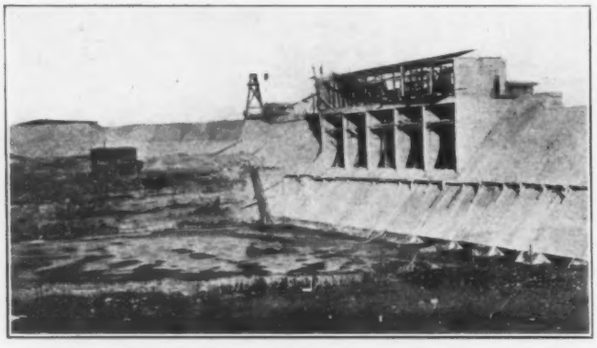


Fig. 3—View of Upstream Side of Cannon Falls Dam and Power House Before Completion.

through pull rods and bell cranks, no high-tension wiring appearing on the main switchboard.

The transformers which raise the emf to the line potential of 33,000 volts are inclosed in concrete compartments along the bulkhead wall of the power house. These compartments are closed by self-releasing steel doors; in case of fire or undue temperature rise a fusible link in the detent mechanism allows the door to roll shut. Two 1250-kw, three-phase, oil-insulated, water-cooled transformers are installed, the circulating water for cooling the units being taken from the upper level impounded by the dam.

From the transformers the high-tension buses are led upward through oil switches in the overhead high-tension gallery to the line entries and lightning arrester taps in the tower structure.

The transmission line from Cannon Falls to Faribault is of the same unique "wishbone" type of construction developed by the Byllesby company and employed in the Mankato-Blue Earth line described in the *Electrical World*, Dec. 1, 1910, and April 13, 1911. A 2300-volt tap from the generator buses also is taken

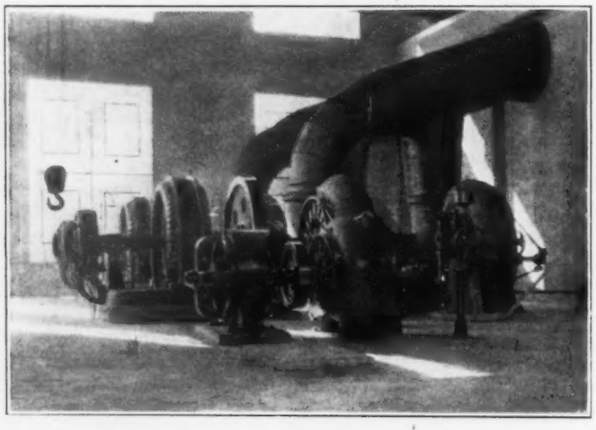


Fig. 5—Waterwheels and Generators in Cannon Falls Hydroelectric Plant.

to Cannon Falls, two miles distant, energy for the city and commercial lighting of the town being supplied from the new dam. While the present equipment of the Cannon Falls development comprises two 750-hp units, making 1500 hp in present installed generator rating, the equipment will be doubled as already provided for, increasing the rating 3000 hp.

The construction of the dams and power house at Cannon Falls and the substations at Northfield, Faribault and Mankato, together with the reconstruction of the steam reserve stations at the latter points, was done by the engineering department of H. M. Byllesby & Company, Chicago, of which Mr. Otto E. Osthoff is vice-president and chief engineer; Mr. W. R. Thompson, assistant chief engineer; Mr. J. W. Link, hydraulic engineer. Mr. E. C. Bacot was the designing engineer of the electrical equipment.

The contract for the dam was carried out by the Ambursen Hydraulic Construction Company, Boston. The Pelton Water

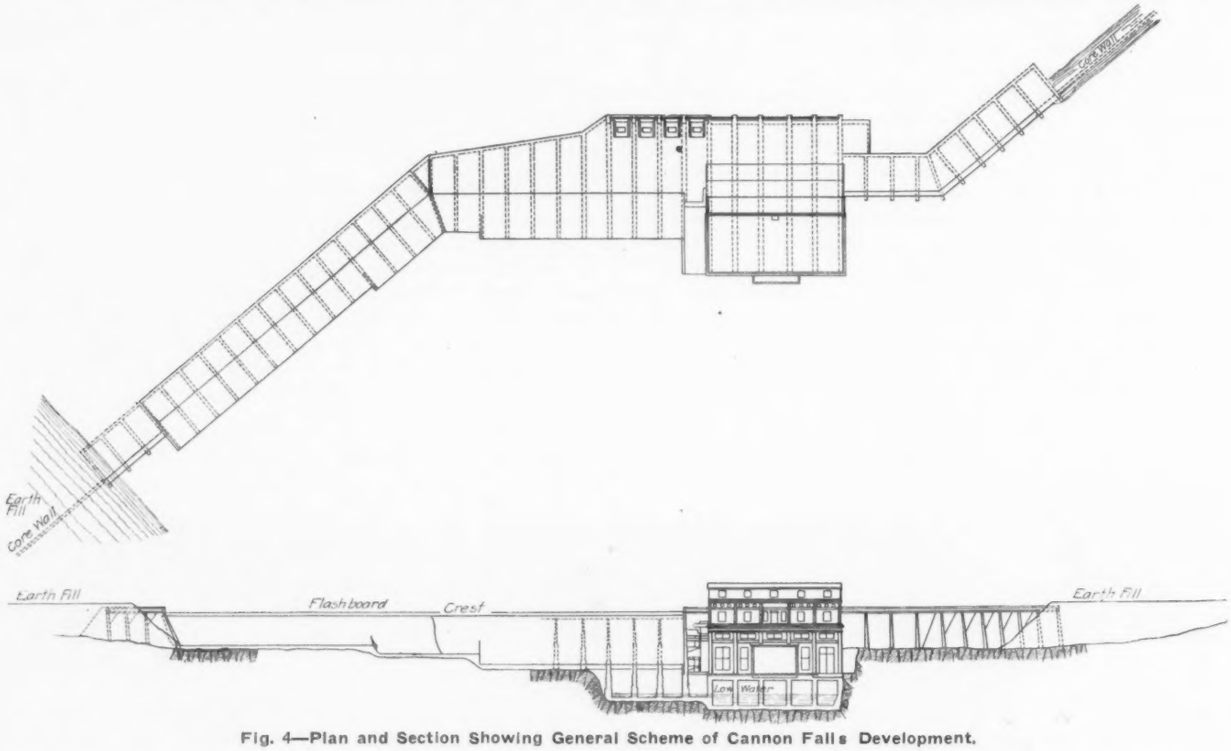


Fig. 4—Plan and Section Showing General Scheme of Cannon Falls Development.

Wheel Company furnished the wheels and governors, and the General Electric Company the electrical apparatus.

Acting for H. M. Byllesby & Company in the field were Mr. D. M. Bunn, construction superintendent in charge of power house, substations and transmission lines, and Mr. J. W. Gilbert,

Fig. 6—View of Power House and a Portion of the Dam.

resident engineer at the Cannon Falls dam. The operating department of the Byllesby company is represented by Messrs. B. W. Cowperthwaite and J. E. Hanson, managers respectively of the Faribault and Northfield divisions of the Consumers' Power Company.

ELECTRIC MOTOR SERVICE IN LARGE TEXTILE MILLS.

A Description of the 17,500-kw Motor Installation in the Plants of the Amoskeag Manufacturing Company at Manchester, N. H.

ELECTRIC motor driving plays an important part in the operation of the largest cotton and worsted mills in the world, which are grouped in the plant of the Amoskeag Manufacturing Company, at Manchester, N. H. Nearly a mile of cloth is produced per minute in this establishment, which employs 19,500 persons, has an annual payroll of about $7,000,000 and a total power-producing capacity in water-wheels, steam engines and steam turbines of about 40,000 hp. The annual coal consumption of the mills approximates 200,000 tons. The buildings occupy nearly 6,000,000 sq. ft. of floor space and are supplied with telephone service from a private exchange having over 400 instruments connected and needing the services of five operators. The mills occupy land on both sides of the Merrimac River in Manchester, and the distance from the northern to the southern end of the plant is about two miles, the width of the property being about one mile. Through the courtesy of Capt. Charles H. Manning, superintendent of motive power, the following particulars of the electric motor drive are given.

The mills are divided into northern, central and southern sections, and electricity for lighting and power service is supplied from two large steam-turbine plants located near the northern and southern centers of production and also from generators located at a number of scattered points on the east side of the river. The largest power plant for electrical supply is the turbine station in the northern division, which at present contains two 4000-kw horizontal Curtis-General Electric units delivering three-phase current at 2250 volts. Sixty-four 150-hp Manning vertical boilers are installed in a single row in the boiler house of this station, the coal being fired by Jones underfeed stokers after being wheeled to the boiler-room from a great storage yard immediately outside. The fuel is unloaded by electricity from the railroad which ships it to the plant. Ample room for expansion of power-producing capacity is available in this station. The southern turbine station at present contains a 2000-kw vertical Curtis-General Electric unit, with space for additional equipment as needed.

The generator leads in the basement of the northern turbine station are carried to the switchboard section in Orangeburg fiber conduits with solid concrete envelopment. All wiring in the station, including instrumental and auxiliary transformer connections, is run in iron conduit. Other electric generating plants are a 1000-kw, 600-volt Westinghouse three-phase alternator in the southern division arranged for driving by water-wheel and reciprocating engine together; a 500-kw synchronous generator in the central division arranged for alternative driving by water-wheel or engine connections; a 2500-kw, 600 volt unit in the central division, steam-driven; a 200-kw, 600-volt unit in the same division, steam-driven; a 1000-kw steam-driven unit in the central division, and in the northern division a 500-kw, 600-volt unit driven by water-wheels and a 2000-kw, 2250-volt water-driven generator. An interesting feature of the power situation is the use of synchronous generators on water-wheel shafts. When the water supply is ample these are driven by hydraulic turbines, but when the river is low these generators are operated as synchronous motors with current from the steam-turbine installation, and by driving a portion of the load carried by the water-wheel shafts enable continuous service to be maintained in portions of the plant which might otherwise have to be shut down. The northern division will shortly be equipped with three synchronous generators rated at 2000 kva, 1000 kva and 375 kva and wound for 2250-volt service. These machines will materially raise the power-factor of the system, which is at present about 85 per cent. The lighting and power loads of the mills are supplied from common busbars in the generating stations, Tirrill regulators being installed to maintain steady voltage.

The company began to install electric motors about nine years ago, using 600-volt, three-phase induction outfits. About 4500 kw connected load in 600-volt motors is in service to-day. For the past six years the practice of installing 2250-volt motors has been considered standard by the motive-power department and the result has obviously been a great saving in copper over the cost of extending the original system operated on moderately low-potential service. There are now 13,000 kw of 2250-volt motors in service in the mills, so that the total connected motor load figures 17,500 kw at the present time, or nearly one-half as much as the total connected motor load of the Boston Edison company's system. All the motors are wound for 60-cycle service and the larger sizes are provided with external starting equipment applying power to the windings in steps. There are about 275 motors in the plant, ranging in average size from 200 hp to 25 hp. The motors are largely of General Electric manufacture, although a few Westinghouse and other makes are in service. On account of the care with which the motors are wired and maintained the company has so far not had a single accident to its employees resulting from the electric drive and, as is generally the case in textile work, the introduction of electricity into loom driving has resulted in increased production and a better quality of cloth on account of the great steadiness of electric as compared with other motive powers. The curve of voltage regulation at the power station busbar is a clean circle on the recording voltmeter and the results at the textile machinery follow as a matter of course. Hundreds of quarter-turn belts, line shafts, pulleys and other obstructions have been eliminated by the electric drive and it is now the standard method of machine operation in all parts of the plant where water-power is not available, only excepting a few instances where the steam-engine drive has not as yet been superseded. In addition to the foregoing improvements the motor drive has effected a gain in the operating spaces available in different departments, has decreased the chances of accident to operatives and has enabled the company to check its power consumption with a convenience and accuracy entirely out of the question with the older forms of mechanical driving. The saving in frictional losses, while not available in figures, has been very large.

Motors are selected on the basis of careful tests of the power requirements of the machines to be driven, with due regard to the elimination of all possible mechanical driving fixtures which can be cut off without sacrificing the flexibility of the installa-

tion. In general, the mills are equipped with the group drive, the motors being centrally located and accessible for inspection and repairs. Usually, too, the power required to operate spinning frames is determined by running a group of frames temporarily by a 10-hp motor, testing the power consumption of the frames when running empty, with the spindle half loaded and with the bobbin ready to empty. In the new Coolidge mill, completed early last year, ninety-six motors of 25-hp rating each drive approximately 380 frames of 272 spindles each on a single floor, or 43.5 spindles per horse-power.

The power requirements of loom work are tested by temporary use of larger motors, sometimes as high as 50 hp or 75 hp each. The motors are run with the shafting only to get the friction load, and then a test is made with 75 or 100 looms connected. The power required varies from ⅛ hp to ¼ hp per loom in cotton work, depending upon the width and design of the loom, the style of cloth, etc. Power requirements in miscellaneous service are tested by temporary motor installations in the same general way. Every motor in the mills is provided with an index card, 5 in. x 8 in. in size, upon which are kept the date of installation, the kind of motor, voltage of the supply circuit, rated horse-power and horse-power developed by test in service, together with the location of the motor, list of machinery driven by it, direction of rotation, number of poles, synchronous and full-load speeds, and the diameter, face and bore of the driving pulley. Typical data taken from a few representative cards are shown abridged in the following tabulation:

Motor No.	Rating Hp.	Volts.	Hp Delpd.	Speed r.p.m.	Pulley Data.			Machines Driven.
					Dia.	Face.	Bore.	
69	200	2,250	216	575	29	24	25	17 wool-twisting frames.
64	125	2,250	128	585	32	20	4.5	12 272-spindle wool spinners.
19	150	600	150	580	30	18	4.875	192 60 in. looms 64 54 in. looms 126 two-box l'ms. 92 four-box l'ms.
5	75	2,250	65	700	20	12	3	French draw'g and mule spinners.
66	50	2,250	43	885	13	13	3	18 fly, 4 intmdte. f'mes. 7 slubbers.
73	25	2,250	18	1,728	8.5	15.25	2.375	Four 272-spindle spinning frames.
122	60	2,250	58	700	18.75	15	3.5	Three blowers, one pump.
127	270	2,250	——	200	syn. direct-conn.			One air compressor

The practice of maintaining such data for all motors installed in the mills has proved to be most useful in reducing idle investment in motor capacity; in determining the power requirements of various divisions of departments, and in facilitating the transfer of motors from one location in the mills to another. In so large a plant there are constant changes in motor locations. The number of each motor remains with it during its life, regardless of where it may be operating, and it is painted on the end shield in yellow, an arrow showing the direction of proper rotation also being painted on the shield in the same color. If a motor is transferred from one grand division to another a letter corresponding to it is placed upon the frame, so that motor No. 100, for instance, originally in service in the southern division and later transferred to the central division, becomes No. "100-C," to distinguish it from motor "100," of the central division, which may already be in service there. Motor numbers and record cards begin in each division at unity and work upward seriatim. Motor tests are made in service either by the use of an indicating meter reading in kilowatts directly, or by the reading of ammeters in the phases and the determination of the power output at a given measured speed from characteristic curves in the possession of the motive-power department. The company maintains such a curve for every motor in its service. In case new or additional machinery is installed on a given motor drive, or in case any machines are withdrawn, a new power test is at once made by the electrical engineering department, and the developed power recorded on the motor index card.

Motors are inspected four times daily, with temperature readings, in the summer season by regular maintainers. The temperatures of the frames are recorded on blanks furnished for the purpose, and each maintainer is provided with a pocket thermometer for this work. Outside the spinning departments about thirty motors are assigned per maintainer, and in the spinning-rooms fifty motors per man are apportioned. The bearings are felt at each inspection in addition to the temperature readings on the stator. Spare coils are carried in stock by the company, and ordinary repairs are made locally. All 2250-volt motors in the mills are provided with slate controlling panels carrying permanently connected ammeters, and an automatic oil switch with no-voltage release coil for each motor. The larger motors, particularly those in loom work, are usually separated by partitions of glass and wood from the operating rooms. Forced ventilation is provided in cases where such motors are housed in the center of a working-room and away from any windows or natural air currents. Cool air is introduced to the motor frames by galvanized-iron duct connections, and the air supply is forced into the compartments by 14-in. fans driven from the line shafts which the motors operate. A few direct-current, variable-speed motors are in service in the operation of cotton and wool tenters. These motors are usually rated at 25 hp each, and ordinarily drive two tenters each. The regular mill hours are from 6:30 a. m. until noon, and from 1 p. m. to 6 p. m., except Saturdays, when the mills close at noon. The starting and stopping of motors is under the direction of department foremen, the work usually being done by so-called "second hands," or foremen's assistants. The electrical department is responsible for the care, inspection and cleaning of the motors, including their maintenance.

All motor frames, switch boxes and conduits are grounded, including both sides of junction boxes. No fuses are employed on motor circuits, and every motor is equipped with an automatic circuit-breaker. Each power circuit at the generating station switchboard is equipped with an indicating wattmeter and an automatic overload oil circuit-breaker, with time-limit relay, and connections are made to frequency and power-factor indicators. Miscellaneous motor applications in the mills are the driving of machine-shop tools, rotary pumps for condensing apparatus, air compressors for general motor and machine cleaning, toilet and lavatory ventilation, operation of large fans on heating service, running of elevators, and the operation of seven electric trucks used in hauling material about the yards. The company maintains a large and well-equipped garage, which has already been described in this paper. Motors are usually installed as near their normal ratings as possible. Numerous clutch connections are provided in the shafting arrangements, so that the temporary shutdown of a motor will not halt production for any length of time. Quite a few motors are also in service driving arc-lighting generators in various portions of the plant, the total capacity of this equipment being about 2000 kw. On account of the reduction in heavy shafting effected by the motor drive it has been unnecessary to strengthen the flooring and ceiling in the older mills where mechanical drives have been replaced by motors. At the main switchboards in the generating stations emergency connections are made with the lines of the Manchester Traction, Light & Power Company, double busbars being provided, with double-throw, remote-control switches. All conduit in the plant is painted pea-green. Oil switches are usually set at 125 per cent load for motors driving machines that start easily, and at 150 per cent of normal load for machinery which starts with difficulty. In the case of eight sets of Brush arc machines, which are driven in pairs by a direct-connected 200-hp induction motor in each case, flexible rubber couplings are provided for insulating purposes between the motor and the generators.

The latest installation of motor-driven machinery is in the new Coolidge mill, which is located on the west bank of the Merrimac River about 2500 ft. from the turbine station of the northern division. In this mill are 127 motors of the induction type, with a total rating of about 5000 kw. Power is trans-

mitted across the river by way of an island in its channel, the porcelain insulators supported on steel towers. There are nine 300,000-circ. mil copper cables, which are carried on spans, and the cables are paralleled electrically to form one three-phase circuit of 900,000-circ. mil capacity per leg. The Coolidge mill is four stories in height, 704 ft. long, 103 ft. wide, and has two wings, each 204 ft. long and 103 ft. in width. The electrical service for the mill is received at the top of a central brick tower and brought to a general supply busbar set in a fireproof compartment on the upper floor level, the tower being anchored into the building proper by steel rods and turnbuckles, on account of the diagonal approach of the electric feeders. The entire wiring of this mill is carried in conduit, with condulet outlets, and the standard cable used is of the triple-conductor varnished-cambric type, with an insulation test of 7500 volts and a working guarantee of 3000 volts.

The distribution arrangement at this mill is of a novel character. Vertical copper busbars are carried downward through the central tower past each floor, and at each level where power is required in the mill a center of distribution has been established. The busbars are 2.5 in. wide x ¼ in. thick, and are hung 24 in. apart on centers from strain insulators attached to two steel channel irons carried horizontally across the tower at the top. The bars are held in place by guide insulators attached to hard pine vertical base strips, kiln-dried, paraffined and shellacked with five coats. The busbars and bases are each surrounded on three sides by solid concrete barriers from 8 in. to 14 in. thick and 14 in. deep, and the total length of the bars is about 90 ft. Each floor is built of concrete with an insulating cork matting on top. A main supply panel is located at the top of the tower, with automatic oil circuit-breaker, the latter being wired for emergency tripping from the different mill floors in case of trouble by the simple method of opening a small knife switch on a low-voltage auxiliary circuit. The line from the power plant to the Coolidge tower is built with insulators arranged in series of four at each attachment, in order to preserve the continuity of service in case of one or two broken insulators. The tops of the steel towers are connected by a grounded line, and the mill tower is equipped with a set of electrolytic lightning arresters. Every group of sixteen 25-hp motors in the mill is provided with a separate feeder panel with automatic oil switch and time-limit relay in the busbar tower, and also an indicating wattmeter. The time-limit relays in the tower are set for operation at from twenty to twenty-five seconds overload. Each feeder circuit is carried from the tower in conduit to its two groups of eight motors, taps being made at each motor to the controlling oil switch at the latter. The size of the tap is equivalent to the carrying capacity of the switch in the tower on the motor panel, so that no fuses are necessary at the motor. Platforms are carried across the manufacturing rooms past the motors, so that each is quite accessible for accurate inspection. The time-limit relays on the motor oil switches are in general set for operation after eight seconds' overload. The vertical busbars are not carried below the first floor, but the concrete recesses in which they are set are carried to the basement, permitting extension in the future if necessary.

INDUCTANCE OF THREE-PHASE TRANSMISSION LINES WHEN THE CONDUCTORS LIE IN THE SAME PLANE.

By Alfred Still.

In an article by the present writer in the *Electrical World*, May 23, 1908, certain formulas were evolved by the aid of which the total induced emf can be calculated in any one of the conductors of an alternating-current transmission system whatever may be the arrangement of the conductors.

In the present article it is proposed to consider the special case, which frequently arises in practice, of the conductors of a three-phase transmission being arranged as indicated in Fig. 1—that is, with the centers of the three conductors lying in the same plane, the minimum distance, D, between any two of the wires being approximately equal to the side of the equilateral triangle which would have been adopted had the triangular arrangement been decided upon. The formulas

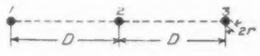


Fig. 1—Three Conductors in One Plane.

used, if not identical in all respects with those used in the article previously referred to, will be such as can readily be derived therefrom.

In the subsequent calculations of the magnetic flux and the induced emfs resulting therefrom no account has been taken of the magnetic lines of induction *within* the material of the conductors. The error is usually negligible, and some simplification is thereby introduced.

In a three-phase transmission system the current flowing out through any one wire may be considered as returning along the two remaining wires, and when the three conductors occupy the vertices of an equilateral triangle the whole of the return current is at a distance D from the outgoing current. This condition also applies to the middle conductor (No. 2) in the arrangement, shown in Fig. 1; but it does not apply to either of the outside conductors, Nos. 1 and 3. In the case of conductor No. 1 a part of the outgoing current returns along conductor No. 2 at a distance D, while the remainder returns along conductor No. 3 at a distance $2D$; so that the total flux of induction surrounding conductor No. 1 must necessarily be greater than that surrounding conductor No. 2. The same argument applies to conductor No. 3.

In the earlier article, to which reference was made at the outset, the formula which gives the induced volts per mile of single conductor, on the assumption of the sine-wave form, is:

$$E = 0.004655 \times f \times \left[-I_1 \log \frac{D_1}{r} - I_2 \log \frac{D_2}{r} \cdots - I_n \log \frac{D_n}{r} \right] \qquad (1)$$

where f = the frequency, r = the radius of the conductor and I_1, I_2, etc., are the currents in the several conductors carrying the return currents at the respective distances D_1, D_2, etc., from the center of the conductor for which the calculation is to be made.

Applying this formula to the arrangement of conductors, as shown in Fig. 1, the quantity between brackets in the case of conductor No. 1 becomes:

$$-I_2 \log \frac{D}{r} - I_3 \log \frac{2D}{r}$$

$$= -(I_2 + I_3) \log \frac{D}{r} - I_3 \log 2$$

$$= I_1 \log \frac{D}{r} - I_3 \log 2$$

The total induced emf per mile of conductor No. 1 will therefore be:

$$E_1 = 0.004655 \times f \times \left[I_1 \log \frac{D}{r} - I_3 \log 2 \right] \qquad (2)$$

Similarly, for conductor No. 3:

$$E_3 = 0.004655 \times f \times \left[I_3 \log \frac{D}{r} - I_1 \log 2 \right] \qquad (3)$$

while the volts induced in the middle conductor (No. 2) will be simply:

$$E_2 = 0.004655 \times f \times I_2 \log \frac{D}{r} \qquad (4)$$

It is interesting to note that what may be referred to as the disturbing element in the case of the two outside wires (the quantities $I_3 \log 2$ and $I_1 \log 2$ respectively) is not dependent

upon the actual diameter or distance apart of the conductors. It consists of an emf component either 30 time-degrees or 150 time-degrees behind the phase of the line current, depending upon the order of the phase rotation; and the magnitude of this emf component relatively to the total emf of self-induction will depend upon the value of the ratio $\frac{D}{r}$. If D is large and r relatively small, as in the case of a high-pressure overhead transmission system, then the first quantity between brackets, in equations (2) and (3), is relatively large, and the disturbing element ($I_3 \log 2$ or $I_1 \log 2$) is usually negligible. On the other hand, if the conductors consist of three separate single cables, laid side by side in a trench, with the distance, D, between them small in comparison with the diameter, $2r$, of the cables, then the "disturbing element" becomes of greater importance relatively to the total self-induction or induced emf.

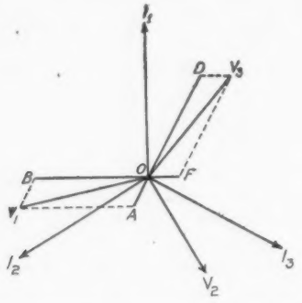


Fig. 2—Vector Diagram of Current and Voltage Relations.

In order to form some idea as to the magnitude of this out-of-balance component of the induction it will be well to work out two numerical examples, one for a high-tension overhead scheme and the other for a low-tension transmission system with the three conductors in comparatively close proximity.

Example 1.—Assumed data: Three-phase power transmitted = 20,000 kw; emf = 110,000 volts; power-factor = 0.8; frequency (f) = 25 cycles per second; length of line = 200 miles. Conductors of aluminum; diameter, $2r = 0.6$ in. Minimum distance between wires, $D = 10$ ft. = 120 in. On the above data the current per conductor is about 130 amp. With the aid of formulas (2), (3) and (4) it is an easy matter to determine the induced emfs in the several conductors, and since the quantity, $\log \frac{D}{r} = \log \frac{120}{0.3} = 2.6021$, while $\log 2 = 0.3010$, it will at once be seen that the "disturbing element" is relatively small.

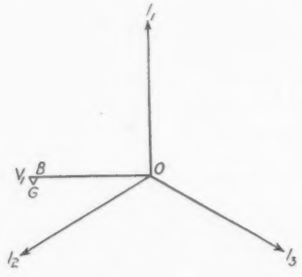


Fig. 3—Vector Relations When Conductors Are Transposed.

The emfs induced in each conductor 200 miles long in round figures are as follows: In the middle conductor (No. 2), 800 volts, the time-phase of which is exactly one-quarter cycle behind the time-phase of the current I_2.

In conductor No. 1, an emf component of 800 volts, exactly a quarter cycle behind the current I_1 less another component (referred to as the disturbing element) equal to about 90 volts, the phase of which is exactly one-quarter cycle behind the current I_3. The resultant is the difference between two *vector* quantities separated by a time-phase angle of 120 deg., so that this resultant is actually *greater* than either of the two components, as will be shown hereafter.

In conductor No. 3 there will be an emf component of 800 volts, one-quarter cycle behind the current I_3, and a component of 90 volts, one-quarter cycle behind I_1.

Example 2.—Assumed data: Three-phase power transmitted = 20 kw; emf = 110 volts; power-factor = 0.8; frequency (f) = 60 cycles per second; current per wire = 130 amp; distance of transmission = ½ mile; three single cables in trench, lying in the same plane with a distance between centers $D = 3$ in.; diameter over copper = $2r = 0.5$ in.

In this example the quantity $\log \frac{D}{r}$

$$= \log \frac{3}{0.25}$$

$$= 1.0792.$$

The ratio between log 2 and this number is $\frac{0.3010}{1.0792} = 0.28$. That is to say, the component of the total induced emf, which appears only in the two outside conductors, as indicated by formulas (2) and (3) in this example, is numerically equal to more than a quarter of the more important component; while in the previous example of a high-tension overhead transmission system the ratio was $\frac{0.3010}{2.6021} = 0.115$, being considerably smaller because of the greater distance between the wires.

Vector Diagram Illustrating Example 2.—The vectors I_1, I_2 and I_3 in Fig. 2 represent the currents in the three conductors, the time-phase angle between them being 120 deg. The rotation of the phases is assumed to be in the order I_1, I_2, I_3; in other words, I_2 lags behind I_1 by one-third of a cycle, and I_3 lags behind I_2 also by one-third of a cycle. The lengths of these vectors are such as to represent the line current of 130 amp; as the diagram has been drawn to illustrate the phase angles and magnitudes of the various components of the induced emfs the magnitude of the current vectors need not be considered. If the numerical values of the induced volts are determined with the aid of formulas (2), (3) and (4) it will be found that the component common to all three conductors amounts to approximately 19.5 volts, while the "disturbing element"—that is, the component appearing in the two outer conductors only—amounts to 5.5 volts.

The vectors OB, OV_2 and OD must, therefore, be drawn of such a length as to represent 19.5 volts in a direction exactly 90 time-degrees behind the corresponding current vectors; and, so far as the middle conductor is concerned, the vector OV_2 will represent the whole of the induced emf; but in the case of conductor No. 1 (carrying current I_1), OA must be drawn exactly 90 time-degrees *in advance* of OI_3—that is, exactly *opposite* to OD, because of the negative sign in equation (2)—and of such a length as to represent 5.5 volts. By combining OA with OB in the usual way OV_1 is obtained as representing the total emf induced in conductor No. 1. In a similar manner OV_3 is obtained for the total induced emf in conductor No. 3. It is interesting to note that OV_1 lags behind the current I_1 by a time interval *greater* than a quarter period, while the lag of the induced volts V_3 behind the current I_3 is less than a quarter period.

In the particular example under consideration the numerical value of V_1 or V_3 as scaled off from the diagram is 22.75 volts, V_2 being 19.5 volts.

Effect of Transposing the Conductors.—If each conductor in turn is made to occupy the position midway between the remaining two conductors for a distance equal to one-third of the total distance of transmission it is obvious that the out-of-balance effect will be corrected. It will, however, be of interest to ascertain what will be the numerical value of the (equal)

voltages induced in the three conductors if transposed in the manner suggested. It is not necessary to consider more than one of the conductors, and, in Fig. 3, OB represents (as in Fig. 2) that portion of the emf induced in conductor No. 1 which remains unaltered whether the conductor be midway between the other two or be itself one of the outer conductors. The length of this vector will, therefore, be such as to represent 19.5 volts. Now, when the arrangement of the conductors is in the order 1, 2, 3 (as in Fig. 1), the "disturbing element" will be BG, drawn 90 deg. *in advance* of OI_3, exactly as OA (or BV_1) in Fig. 2; but the *length* of this vector, instead of being equivalent to 5.5 volts, will be only one-third of this value, or 1.83 volts, because conductor No. 1 occupies this position over only one-third of the total distance of transmission. When the arrangement of the conductors is 1, 3, 2, the "disturbing element" will be GV_1 (Fig. 3), drawn 90 deg. in advance of OI_2. Clearly BGV_1 is an equilateral triangle, and the resultant of the induced emf in conductor No. 1 is OV_1, drawn 90 time-degrees behind the current vector OI_1 and equal in magnitude to the algebraic sum of $OB = 19.5$ volts and $BV_1 =$ one-third of 5.5 volts.

If, therefore, the wires of a transmission line are disposed in one plane, as indicated in Fig. 1, but transposed at intervals so that each wire shall occupy the middle position over a space equal to one-third of the distance of transmission, then the resultant induced emf per conductor will, so far as phase is concerned, lag behind the current by a quarter period, exactly as if the wires occupied the vertices of an equilateral triangle; but the amount of the induced volts will be somewhat greater than in the latter case under otherwise similar conditions.

The numerical value of the induced volts per conductor—that is, the length of the vector OV_1 in Fig. 3—can be calculated by the formula:

$$E = 0.004655 \times f \times \left(I \log \frac{D}{r} + \frac{I \log 2}{3} \right) \qquad (5)$$

where I is the current in any one conductor and the two quantities between brackets are merely to be added algebraically.

INDICATING ALTERNATING-CURRENT METERS.

By J. H. Morecroft.

IT is the purpose of this brief article to give a suggestion of the precautions necessary, especially in accurate work, when using indicating meters for measuring emf, current and power in an alternating-current circuit.

The fundamental unit in alternating-current work is the ampere and is defined as that value of alternating current which, when flowing through a circuit containing a certain ohmic resistance, will generate heat in that resistance at the same rate as it is generated by the direct-current ampere flowing through the same resistance. The term "ohmic" is used to make the definition complete. If a coil of wire is wound upon an iron core, heat will be generated in the circuit much faster when an ampere of alternating current is flowing through it than when an ampere of direct current is flowing in the circuit. It is only the heat set free by the current flowing against the ohmic resistance reaction which is used to define the ampere of alternating current.

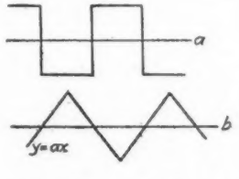


Fig. 1—Square-Top and Pointed Waves.

As the heat generated in a circuit at any instant varies as the (current)^2 we have the following relation:

If a = instantaneous value of alternating current,
A = maximum value of alternating current,
I = value of direct current to generate same amount of heat per second as is generated by alternating current,
R = ohmic resistance of circuit (no iron in circuit).

$$\int_o^\pi a^2 R dt = [I^2 R]_o^\pi \text{ or}$$

$$I = \left(\frac{1}{\pi} \int_o^\pi a^2 dt \right)^{1/2}$$

As the quantity in the parenthesis is the average value of a^2, we have the fundamental definition that the effective value of any alternating current, no matter whether the current is a sine wave or not, is equal to (average value of (instantaneous value)^2)$^{1/2}$. When the alternating current is a sine wave $I = \frac{A}{\sqrt{2}}$. It is noticed that this differs from the average value of the alternating current, which is $\frac{2A}{\pi}$ for a sine wave. The ratio of the effective value to the average value is called the form factor and is 1.11 for a sine wave. If the wave is of a square form (a, Fig. 1) the form factor is equal to one, while if the wave is triangular in shape (b) the form factor is

$$\frac{a\pi}{\sqrt{3}} \Big/ \frac{a\pi}{2} = \frac{2}{1.73} = 1.16.$$

From these values it is readily seen that the ratio of the average value of the current to the effective value varies greatly with the shape of the current wave.

When a current is passed through a measuring instrument designed for alternating current the moving element moves away from its zero position and takes up some position where the average value of the impelling force (due to the current) is just equal to the value of the resisting force (spring, force of gravity, etc.).

Now, according to the construction of the meter, the impelling force may vary directly with the first power of the current flowing through the instrument or with the second power, etc.

It is evident from the definition of the ampere of alternating current that if the meter is to record accurately on various wave forms the impelling force must vary with the (current)^2. As the ampere is defined as the (average value of (current)^2)$^{1/2}$, and the reading of the meter is proportional to the average value of the impelling force, the impelling force must vary as the square of the current. In the case of the hot-wire and dynamometer types of instruments this is strictly true; in the case of instruments employing a moving iron vane (Weston and Thomson) it is approximately true. The force acting on the iron vane is proportional to the strength of the magnet (the iron vane becomes a magnet by induction) times the strength of magnetic field in which it is situated. The field strength varies directly as the current, and so long as the permeability of the iron vane remains constant its pole strength varies directly as the current, so that the impelling force varies with the (current)^2.

A meter whose impelling force varies directly with the current, if calibrated with sine-wave current, will not read accurately when used with a wave form differing from sine form. The magnitude of its error will be measured by the ratio of the wave-form factor to the form factor of a sine wave.

Now if the current being measured is a distorted wave it may be represented by a fundamental sine wave and a series of harmonics of various amplitudes. If the impelling force of the meter is proportional to the square of the current the reading of the meter will be equal to $\sqrt{A_1^2 + A_2^2 + A_3^2 + \ldots}$, where A_1, A_2, A_3, etc., represent the amplitudes of the fundamental and the various harmonics.

Consider the case of an alternating-current ammeter record-

ing the exciting current of a transformer. This wave is much distorted, but may be fairly represented by the equation

$$x = A_1 \cos pt + A_3 \cos (3pt + \Theta)$$

where

A_1 = amplitude of fundamental,
$p = 2\pi \times$ fundamental frequency,
A_3 = amplitude of third harmonic.
Θ = distance on X axis between the zero value of the two waves, as in Fig. 2.

Now the meter reading with such a current will be proportional to the average value of the impelling force or average value of x^2.

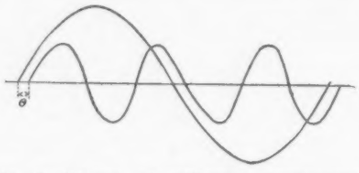


Fig. 2—Waves of Different Frequencies.

$$\text{Average force} = \frac{1}{\pi}\int_0^{\pi} \left\{A_1 \cos pt + A_3 \cos (3pt + \Theta)\right\}^2 dt$$

$$= \frac{1}{\pi}\int_0^{\pi} A_1^2 \cos^2 pt\, dt + \frac{1}{\pi}\int_0^{\pi} A_3^2 \cos^2 (3pt + \Theta)\, dt$$

$$= \frac{1}{\pi}\int_0^{\pi} 2A_1A_3 \cos pt \cos (3pt + \Theta)\, dt$$

The values of the first two integrals are quite evidently

$$\frac{A_1^2}{2} \text{ and } \frac{A_3^2}{2} \text{ respectively.}$$

The third integral can be obtained by expanding the term $\cos (3pt + \Theta)$.

$$\text{The third integral} = \frac{2A_1A_3}{\pi}\int_0^{\pi} \cos pt \cos (3pt + \Theta)\, dt$$

$$= \frac{2A_1A_3}{\pi}\int_0^{\pi} \cos pt\, (\cos 3pt \cos \Theta - \sin 3pt \sin \Theta)$$

$$= K\int_0^{\pi} \cos 3pt \cos pt\, dt - K_1\int_0^{\pi} \sin 3pt \cos pt\, dt$$

Put $\cos 3pt = \cos 2pt \cos pt - \sin 2pt \sin pt.$

$$= (\cos^2 pt - \sin^2 pt) \cos pt - 2 \sin^2 pt \cos pt;$$

therefore,

$$K_1\int_0^{\pi} \cos 3pt \cos pt\, dt = K_1\left[\int_0^{\pi} \cos^4 pt\, dt - 3\int_0^{\pi} \sin^2 pt \cos^2 pt\, dt\right] = \left[\cos^3 pt \sin pt\right]_0^{\pi} = 0$$

In the same way

$$\int_0^{\pi} \sin 3pt \cos pt\, dt = \int_0^{\pi} 3 \sin pt \cos^3 pt\, dt - \int_0^{\pi} \sin^3 pt \cos pt\, dt$$

$$= -\left[\tfrac{3}{4}\cos^4 pt\right]_0^{\pi} - \tfrac{1}{4}\left[\sin^4 pt\right]_0^{\pi} = 0$$

Therefore the force acting on the moving element of the instrument $= K\left(\frac{A_1^2}{2} + \frac{A_3^2}{2}\right)$; and as the meter scale is graduated in terms of the square root of the impelling force, the reading of the meter will be

$$\sqrt{\frac{A_1^2}{2} + \frac{A_3^2}{2}}.$$

But $\frac{A_1^2}{2} = \left(\frac{A_1}{\sqrt{2}}\right)^2 =$ (effective value)^2 of fundamental, and $\frac{A_3^2}{2} =$ (effective value)^2 of the third harmonic current.

The current indicated by the ammeter will thus be

$$I = \sqrt{I_1^2 + I_3^2},$$

where I_1 and I_3 are the effective values of the fundamental and harmonic.

This demonstration may be easily generalized, and it is found that the meter indication for any complex wave is

$$I = \sqrt{I_1^2 + I_3^2 + I_5^2 + \ldots}$$

As the alternating-current voltmeter is an essentially non-inductive resistance, the current flowing through its moving element will be of exactly the same shape as the emf wave. Therefore, when acted upon by a complex wave the meter indication will be $E = \sqrt{E_1^2 \times E_3^2 + E_5^2 + \ldots}$, where E_1 = amplitude of fundamental, etc.

The validity of these two formulas may be readily tested. Connect two alternators of different frequencies in series with one another. Read the voltage of each alternator and of the line and results will be obtained as in Fig. 3. Or two currents of different frequencies, the amplitude of each of which can

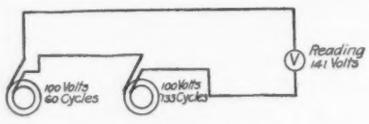


Fig. 3—Superposition of Voltages.

be measured, may be used to check the current formula. Send both currents through the same ammeter and it will be found that the meter reading will be the square root of the sum of the squares of the individual currents.

In electrical quantities the different frequencies are all simply related—that is, there are the third, fifth or seventh harmonics, etc. In case the two frequencies are very nearly alike the integral of the cross product will have different values depending upon the interval over which the integral is taken. The force acting on the moving element of the meter will vary with a comparatively slow period, and if the frequencies are close enough together, the reading of the meter will be a fluctuating one, the amount of fluctuation depending upon the relative magnitudes of the two frequencies. In Fig. 3, if the frequencies were 60 and 60.1 respectively and the voltages each 100 volts, the voltage of the line would oscillate between 0 and 200.

When the question of power measurement in a circuit having either the current or emf, or both, complex quantities is considered the action of the wattmeter must be analyzed.

The field in such an instrument is produced by the current in the circuit, and the current in the moving coil is of the same shape as and proportional to the voltage of the circuit being tested. The impelling force will then vary as the product of these two quantities.

Suppose the emf is simple harmonic

$e = E \cos pt$; and the current complex, as

$x = A_1 \cos (pt + \phi) + A_3 \cos (3pt + \Theta)$

what will the wattmeter read when connected to such a circuit?

$$\text{Average force} = \frac{1}{\pi}\int_0^{\pi} E \cos pt \left[A_1 \cos (pt + \phi) + A_3 \cos (3pt + \Theta)\right] dt = \int_0^{\pi} EA_1 \cos pt \cos (pt + \phi)\, dt + \frac{1}{\pi}\int_0^{\pi} EA_3 \cos pt \cos (3pt + \Theta)\, dt.$$

Now it has previously been shown that an integral of the form of the second term is equal to zero, therefore,

$$\text{average force} = \frac{1}{\pi}\int_0^{\pi} EA_1 \cos pt \cos (pt + \phi)\, dt = \frac{E}{\sqrt{2}}\frac{A_1}{\sqrt{2}} \cos \phi.$$

This analysis may be carried out for a current containing any number of harmonics, but it will be found that the wattmeter reading is equal to the product of the effective values of the emf, and the fundamental current and the cosine of their phase difference. So long as one of the quantities, emf or current, is a simple harmonic the wattmeter reading is entirely independent of any upper harmonics which may exist in the other quantity.

If, however, there is a third harmonic in both emf and

current, then the wattmeter reading will be proportional to

$$\frac{1}{\pi}\int_0^{\pi} (E_1 \cos pt + E_3 \cos (3pt+\gamma))$$
$$(A_1 \cos (pt+\phi) + A_3 \cos (3pt+\Theta))\, dt.$$

Upon evaluation this integral yields two terms, or the

$$\text{wattmeter reading} = \frac{E_1}{\sqrt{2}}\frac{A_1}{\sqrt{2}} \cos\phi + \frac{E_3}{\sqrt{2}}\frac{A_3}{\sqrt{2}} \cos(\gamma-\Theta).$$

That is, the wattmeter reading is the sum of the watts obtained by multiplying the effective value of each voltage by the

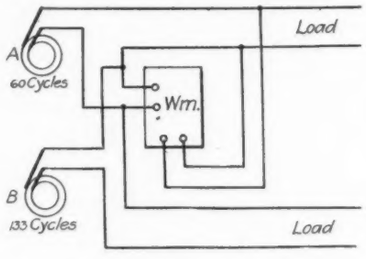


Fig. 4—Superposition of Currents.

effective value of the current of the same frequency by the cosine of their phase difference.

That the conclusions reached in this analysis are correct may be readily proved experimentally. Make connection as in Fig. 4, and arrange the wattmeter to measure the load of alternator A, furnishing power at some convenient frequency, say 60 cycles. Arrange a load on the alternator B of a frequency different from that of A. Pass the current delivered by machine B through the current-coil of the wattmeter. It will be found that the current furnished by machine B has no effect whatsoever on the reading of the wattmeter, it merely indicating the power delivered by machine A. Of course, it will readily be appreciated that the currents and emfs of each machine must be pure sine waves. If the current delivered by machine B has in it some harmonic of the same frequency as some upper harmonic of machine A, then some effect will be produced on the wattmeter when machine B is loaded.

From this simple discussion it is evident why the power-factor of a circuit in which there is flowing a complex current is more or less a fictitious quantity. The ratio of watts to volts × amperes gives a certain number, but the significance of such number is not at once apparent. The wattmeter takes no account of the upper harmonics, but the product, volts × amperes, does involve them indirectly, because the ammeter reads the (root mean square) of the amplitudes of the fundamental and all upper harmonics which may be present. The value of ϕ so obtained does not signify the phase difference of the zero points of the emf and current waves of the circuit. Neither does it signify the phase difference of the emf and the fundamental current wave. The real significance of ϕ so obtained is the phase displacement of the emf and a fictitious simple harmonic current, the effective value of which is the same as that of the complex wave, the frequency of which is the same as that of the fundamental current, and the phase of which is such that it would produce on the wattmeter the same effect as is produced by the actual complex wave.

Questions which involve the points brought out in the above analysis may, and undoubtedly will, arise when specifications of power consumption in circuits involving complex currents are more rigidly enforced. A case to illustrate this point is the magnetite arc fed from the mercury-arc rectifier. This lamp is a direct-current lamp, and one would naturally use a direct-current voltmeter and ammeter to measure the power consumption of such a lamp. But the current delivered by the mercury-arc rectifier is a pulsating one. It may be roughly approximated by the equation

$$x = A + B \sin pt.$$

A direct-current ammeter cannot accurately record such a current. The current supplied to the lamp is really the (root mean square) of the pulsating current, and it is necessary to use an alternating ammeter to get this value. But stray fields, such as the earth's field, may affect the reading of the latter meter in measuring such a pulsating current, and it will therefore be necessary to take reversed readings with the meter and average the two. Shall the power used by such a lamp at the arc be measured by a wattmeter or by volts × amperes?

It has been noted that if a complex emf and current are supplied to a wattmeter its indication will be

$$E_1 I_1 \cos\phi_1 + E_2 I_2 \cos\phi_2 + E_3 I_3 \cos\phi_3 +$$

Suppose that a complex current of the form

$$x = I_1 \cos p_1 t + I_2 \cos(p_2 t + \Theta_1) + I_3 (\cos p_3 t + \Theta_2)$$

is passed through the current coil of a wattmeter and on the potential coil of the wattmeter there is impressed a sine emf of frequency $= p_2$ and amplitude $= E_2$ the reading of the wattmeter will be $E_2 I_2 \cos(p_2 t + \phi)$.

Suppose now there is some method of gradually changing the phase of E_2, with respect to the current passing through the wattmeter; then as ϕ is varied the indication of the wattmeter will vary and will become a maximum when $\phi = 0$. Then the reading of the wattmeter will be $= E_2 I_2$.

As E_2 can be measured, the value of I_2 is readily computed; and if the phase of E_2 is known with regard to the emf causing the complex current to flow, both the magnitude and phase of the upper harmonic I_2 are known. In the same way by impressing on the wattmeter a voltage E_3 of frequency p_3, the third harmonic of the complex current can be measured in phase and magnitude. Here, then, is a very easy method for analyzing complex waves. For high frequencies perhaps the inductance of the wattmeter may introduce difficulties in properly determining phase, etc. But for a rapid and fairly accurate analysis of waves for the upper harmonics, not exceeding perhaps 500 cycles, this method is probably as good as can be obtained.

DIRECT-CURRENT VERSUS ALTERNATING-CURRENT ELECTRICAL EQUIPMENT FOR CRANES.

THE induction motor was early welcomed by engineers in general as a very opportune medium for the direct application of power from alternating-current circuits for general industrial purposes. In comparison with its more mature competitor, the direct-current motor, it was considered to possess desirable simplicity and ruggedness to withstand the abuses of service, as well as good speed regulation, at rated speed, and fair efficiency.

It was, however, recognized as having less desirable torque characteristics and very poor regulation at intermediate speeds, which latter practically eliminated it from the field of adjustable-speed motors.

Between zero and full speed the polar-wound induction motor, with adjustable secondary resistance, has speed-torque characteristics quite similar to a series-wound direct-current motor. The former, however, will not exceed its rated (synchronous) speed, even at no load, and it possesses a certain maximum torque, which, if exceeded, will cause the motor to "break down" and come to rest.

The last-mentioned limitations have not prevented the increasing application of induction motors to cranes, hoists and for other industrial purposes to which the series-wound direct-current motor is generally applicable.

The question of the selection of motors arises in connection with almost every installation of the latter character in an establishment the power for which is primarily generated and distributed in alternating-current form. The power-plant engineer will naturally champion the alternating-current equipment wherever applicable, because it does not require additional capacity in rotaries or motor-generators to convert alternating current into direct current. The shop manager, to whom the ap-

paratus in question is only a part or adjunct to the general manufacturing process, may have had long and satisfactory service from direct-current equipments on the same kind of apparatus, and, having in mind only the continuation of the manufacturing process without embarrassment or interruption, he will insist upon the direct-current equipment.

A good illustration of the foregoing is found in the United States navy yards, in which the use of motor-driven machinery has kept well abreast of the best practice from the beginning. Until about 1905 the navy yards were with few exceptions equipped with direct-current power plants. Subsequent to 1905 the yards at Boston, New York, Philadelphia (partially), Norfolk, Charleston, S. C.; Mare Island, Cal., and Puget Sound, Wash., have been or are being equipped with central stations in which power is generated at 2300 volts, 60 cycles, three-phase, and distributed at 220 volts for power purposes. The yards at Portsmouth, N. H.; Washington, D. C.; Pensacola, Fla., and the naval stations at New Orleans, La., and Cavite, P. I., continue to use the existing direct-current plants.

The introduction of the alternating-current motor in the first-mentioned navy yards, to supersede the direct-current motor for all constant-speed service, has been continued as fast as alternating current has become available.

Naturally the tendency of the alternating-current motor, for reasons above stated, is to encroach farther and farther into the field of the direct-current motor. This movement met with decided opposition when it advanced upon the field of cranes, especially jib and traveling cranes in shops and foundries. In order to obtain a more comprehensive understanding of the relative advantages of direct-current and alternating-current equipments for cranes the Bureau of Construction and Repair, Navy Department, communicated with twelve of the principal American crane manufacturers, and their opinions were solicited upon this subject, having in mind the existing conditions at navy yards. Opinions were invited under the following headings: Reliability, first cost, cost of upkeep and maintenance, power efficiency, and speed and accuracy of control. The different crane builders are designated anonymously by capitals "A" to "L" inclusive. Quotations under "M" are from the opinion of one of the principal users of cranes in this country. To avoid duplication of evidence only those opinions are given which appear to present a different argument from the others.

By permission of the Navy Department and the different crane builders the following are quotations from the replies received. Crane builder "A" preferred not to be quoted on this subject:

RELIABILITY.

Crane Builder "B": "In this respect one motor we consider just as good as the other. The alternating-current motor has a slight disadvantage in that the air-gap is smaller than in the direct-current motor."

Crane Builder "C": "The ——— standard crane design and construction is the same in all mechanical parts, whether equipped with direct-current or alternating-current motors. The use of alternating-current motors eliminates the possibility of overloading the crane to a dangerous extent by careless handling, the maximum torque which these motors will develop being predetermined and proportioned to the work the motor will be called upon to perform under maximum safe conditions; whereas, under similar conditions, in the case of a crane equipped with direct-current motors the current will increase and the torque increases in proportion, resulting either in the motor being burned out or in the crane being damaged by the straining of the parts." (Note:—Such a contingency is guarded against by the installation of overload devices in the electric circuit.)

Crane Builder "D": "As applied to cranes, there may be a slight advantage in favor of alternating current, but such figures as we have at hand do not show any material advantage in this respect. Formerly, probably not over 10 per cent of our electric cranes were equipped with alternating-current motors. More recently we think probably 25 per cent or more have been thus equipped. We have never had any difficulty in applying alternating current to our cranes, for we have so designed them that the mechanical portion of the cranes is interchangeable with either direct-current or alternating-current equipment."

Crane Builder "E": "The alternating-current motor has the advantage due to the fact that it is practically impossible to burn it out owing to overloading, as when the motor is overloaded very greatly it will stall and refuse to operate. This we consider a decided advantage, and it prevents the operator from overloading the crane to a dangerous point."

Crane Builder "F": "The reliability of induction motors for crane service is now beyond question and their use for this service is being continually increased."

Crane Builder "G": "The direct-current apparatus has practical advantages which, in our judgment, serve to offset the superior reliability and the reduced maintenance cost of the alternating-current apparatus. If we had both kinds of current in our establishment we should undoubtedly use direct current for our cranes and for all other cases where a variable speed of motor is desirable."

Crane Builder "H": Less insulation strain on the windings of direct-current motors and no trouble from transformer action caused by small defects in stator or rotor circuits; otherwise, we consider reliability about equal."

Crane Builder "I": "Either type of motor will prove reliable, provided motors of proper size are used on properly designed cranes. When cranes are equipped with alternating-current motors that are required to do hard and continuous service motors of higher horse-power should be selected than when direct-current motors are used."

Crane Builder "J": "Equally reliable."

Crane Builder "K": "So far as we know we made the first alternating-current crane built in this country. It was installed in 1899 and has been in continuous service ever since. But our conclusion is as follows: Alternating-current motors are just as reliable in every way as the direct-current motors."

Crane Builder "L": "Both equipments are successful in performing the functions regularly required of a crane, and it appears more a question of the power plant and the source of energy than one of merely the selection of crane equipment. In large industrial plants it would appear to be a pretty even stand-off whether the alternating-current cranes should be used, with possibly higher cost of crane equipment, or whether converting apparatus should be introduced between the cranes and the power station and direct current used."

FIRST COST.

Crane Builder "B": "An alternating-current crane must necessarily cost considerably more than a direct-current crane. Alternating-current motors usually cost about 35 per cent more than direct-current motors of the same horse-power capacity. Furthermore, it is usually necessary to select an alternating-current motor of larger capacity in order to obtain the requisite starting torque. The capacity of a direct-current motor is limited by its temperature rise only, while in the case of the alternating-current motor the starting torque is the limiting factor, and the motor very often cannot be loaded up to its full temperature capacity. Alternating-current motors, as a general rule, require more space than direct-current motors, which is reflected in the size and weight of the trolley. The wiring is more expensive for an alternating-current crane. On the other hand, if only alternating current is available a motor-generator set is required to transform alternating current into direct-current. We find usually that in cases where alternating current only is available alternating-current equipment is cheaper in first cost if there are only one or two cranes; if, however, there are four or more cranes the total price of all the direct-current cranes, plus the motor-generator, will be less than the total price of all the alternating-current cranes. A generator capacity in kilowatts equal to 20 per cent of the total horse-power rating of all the motors will usually be found ample. In cases where lifting magnets must be

used a direct-current supply must be available. Also, for bucket cranes we consider the direct current very much superior."

Crane Builder "C": "The first cost is in favor of the direct-current equipment, this being about 15 per cent to 20 per cent less than in the case of the alternating current. The first cost of alternating-current-equipped cranes more closely approaches the cost of direct current, as the manufacturers of electrical equipment are commercializing and standardizing the alternating-current equipment. The slight difference in cost is practically offset by the reduced cost of maintenance."

Crane Builder "D": "Alternating-current motors increase the cost of electric traveling cranes, first, because the initial purchase cost of such electrical equipment is higher; second, because the auxiliary electrical devices, like electric brakes, limit stops, etc., are more expensive to make; third, there is a small additional labor cost in the crane itself. The usual additional first cost of a 60-cycle crane over a direct-current, 220-volt crane will run from 15 per cent to 18 per cent."

Crane Builder "E": "The selling price of an alternating-current crane is about 15 per cent to 20 per cent higher than a direct-current crane. This is accounted for by several things. There are only two concerns furnishing alternating-current[1] equipments complete. Alternating-current wiring is more expensive, requiring more wires and wires of larger capacity, due to the wattless current that is flowing at the time of starting the motors."

Crane Builder "F": "The first cost of induction motors is greater than direct-current motors, because it is necessary to use alternating-current motors of larger horse-power on account of the limited overload capacity of such motors."

Crane Builder "G": "The first cost is in favor of the direct-current motors."

Crane Builder "H": "Alternating-current equipment costs more than direct current, ranging, roughly, from 10 per cent to 20 per cent. It is also heavier than direct current for same power requirements."

Crane Builder "I": "The cost of cranes equipped with alternating-current motors are usually considerably more than those equipped with direct-current motors. No proportion can be laid down owing to the fact that cranes are special and the proportion of cost of the electrical apparatus varies greatly."

Crane Builder "J": "About the same first cost."

Crane Builder "K": "The first cost would probably run from 1 per cent to 2 per cent greater for the alternating-current equipment."

Crane Builder "L": "If the customer is compelled to transform alternating current into direct current for the operation of direct-current cranes we should have to add to the cost of the direct-current equipment its proportionate share of the motor-generator or rotary-converter installation, which would doubtless bring the cost of the direct-current crane up very close to the alternating-current crane. There would, therefore, not appear to be a very wide question regarding the cost of crane equipment.

COST OF UPKEEP AND MAINTENANCE.

Crane Builder "B": "There is very little difference to be expected between the two. The motor bearings of alternating-current equipment have to be renewed from time to time on account of the small air-gap. On the other hand, the direct-current motor will require more frequent brush renewals. The commutator will last as long as the slip-rings of the induction motor."

Crane Builder "C": "The cost of upkeep and maintenance on all mechanical parts is equal; on the electrical parts the alternating current has the advantage for reasons explained under the heading of 'Reliability,' although the direct-current motor cannot be considered an expensive machine to maintain."

Crane Builder "D": "Considering the higher cost of repair parts we doubt if there is anything in favor of alternating current under this heading."

Crane Builder "E": "The cost of maintaining an alternating-current crane will be much less than a direct-current crane."

Crane Builder "F": "The cost of maintenance for induction motors we believe is slightly less than for direct current, since the former has no commutator."

Crane Builder "G": "The use of alternating current apparatus will result in reduced maintenance cost."

Crane Builder "H": "Direct-current motors are easier and cheaper to repair, otherwise maintenance appears about equal."

Crane Builder "I": "With properly designed cranes having motors of the proper size the upkeep and maintenance of cranes equipped with alternating-current apparatus should be considerably less than that of those equipped with direct-current apparatus."

Crane Builder "J": "It is our opinion that this would be about the same, if not less, with the alternating-current equipment."

Crane Builder "K": "The cost of maintenance is somewhat less with alternating-current equipment."

Crane Builder "L": "With the recent mill-type design in alternating-current motors there would be little choice in the quality of installation. The direct-current motors, on account of their commutators and brushes, would be probably somewhat more expensive to maintain, but this would be partially counterbalanced by the somewhat increased control maintenance of the alternating-current equipment."

POWER EFFICIENCY.

Crane Builder "B": "Considering a straight alternating-current crane installation, on the one hand, and a direct-current crane installation with a motor-generator set, on the other hand, the former will invariably show a higher power consumption and a lower power factor at the switchboard of the power house than the latter."

Crane Builder "C": "The average electrical efficiency of cranes is about 86 per cent with either direct-current or alternating-current motors, increasing or decreasing according to the horse-power of the motors used."

Crane Builder "D": "We do not consider that the mechanical or electrical efficiency of the alternating-current machines is higher than that of the direct-current."

Crane Builder "E": "We do not believe there is any advantage in either alternating current or direct current."

Crane Builder "F": "In starting, the induction motor consumes a proportionately heavier current than the direct-current and, as crane service requires frequent starting, alternating-current equipment will use more power than direct-current."

Crane Builder "G": "The power efficiency of direct-current motors is considerably greater than the variable-speed induction motors."

Crane Builder "H": "Direct-current motors are superior to alternating-current in that there is no loss due to low power-factor. The average day efficiency is, therefore, greater unless constant loads are handled and a constant line voltage is maintained."

Crane Builder "I": This should be somewhat in favor of the alternating-current equipment."

Crane Builder "J": "In calculating the size of an induction motor for any specific duty, it is very essential to select a motor which will have sufficient maximum torque to meet any demands which it will be called upon to supply in the particular service. The comparative efficiencies of the two types of motors can best be obtained from the motor manufacturers."

Crane Builder "K": No comments.

Crane Builder "L": "With regard to efficiencies there would be no very wide difference in the efficiency of either crane equipment."

SPEED AND ACCURACY OF CONTROL.

Crane Builder "B": "On this subject we consider that there is really no comparison and feel that the direct-current crane

[1]Attention is invited to the fact that Crane Builder "E" considers the market for alternating-current equipments unfavorable, from a commercial standpoint, for the development and adoption of this form of equipment in competition with the direct-current equipment. Note the comment of Crane Builder "C" under "First Cost" upon this point.

is very much superior to the alternating-current. When you have in mind that the average load on the crane hook is only a fraction of the full capacity of the crane it must be evident that the direct-current crane can handle almost twice the work in a given time and for the same horse-power capacity of motor. The characteristics of the direct-current series-wound motor permit of a much closer speed regulation than the alternating-current motor, which will be appreciated whenever accuracy in handling the material is demanded.

"We have given you this information in the shape we understand you desire it, but we cannot let go of the subject without laying some emphasis on the advantages which we feel obtain in the direct-current over the alternating-current motor for crane work generally."

Crane Builder "C": "The maximum speed with full load on a properly designed crane is the same with alternating-current or direct-current motors. This speed increases with the decrease of load on direct-current cranes; on alternating-current cranes this speed is constant. It is possible to handle light loads more expeditiously with direct-current motors. All things being equal, it is generally agreed that 220 volts direct current is most satisfactory."

Crane Builder "D": "In our standard specifications we usually figure that the empty hook or a very light load can be hoisted by a direct-current motor at two and one-half to three times the speed of the full load. With alternating current the maximum speed under any load is practically the same as the full-load speed. This makes the direct-current series-wound motor an especially efficient and valuable adjunct to the modern electric traveling crane."

Crane Builder "E": "We have in this question the real important point that must be considered in deciding whether to use alternating current or direct current. Alternating-current motors do not accelerate nearly as fast as a series direct-current motor. For this reason it is impossible for an alternating-current crane to compete with a direct-current crane in a plant where it is essential that a crane act promptly. We have found that one of the greatest disappointments to the user of alternating-current cranes is the fact that the speed of the hoist is practically the same at light loads as at full loads. We have recently closed a contract[2] with the ——— Company covering several cranes in capacities from 20 tons to 50 tons, all of which are alternating current. This would seem to indicate that this company on account of the advantages in the use of alternating-current equipment is going to give up some speed in handling."

Crane Builder "F": An advantage of the direct-current motor is its increased speed with reduced loads. This characteristic you will note results in a considerable saving in time with direct-current equipment, making it possible to accomplish much more work since most crane movements are with comparatively small loads. Another advantage in favor of the direct-current motor is that if the voltage drops below normal it results in a corresponding drop in speed, but does not reduce its torque, whereas with the induction motor the torque varies with the square of the voltage."

Crane Builder "G": "In the alternating-current apparatus the entire working range of motor speed is not large. With the resistance cut out—that is, with the controller in the last notch—the speed of the heaviest load will be the same as the speed of the lightest; in other words, you cannot lift a light load any faster than you can lift the heaviest for which the crane is designed. With direct-current apparatus you have the great advantage that with light loads the motor will run at an accelerated speed, and you will be able to handle such loads two or three times as fast as your heaviest loads."

Crane Builder "H": "With variable speeds the direct-current motor is more efficient. This is also true with variable loads. Having a larger relative starting torque the direct-current motor will accelerate loads faster than alternating current. On heavy loads that are to be lifted slowly and but a short distance at a time, for example, picking up the cope of a mold in the foundry, the direct-current motor will start and run slowly without speeding up in a way not ordinarily obtainable with the alternating-current motor. Where loads are uniform and where speeds are required which correspond to full load on the motors we believe there is little difference."

Crane Builder "I": "With equal horse-power of motors this should be in favor of the direct-current apparatus, owing to the greater flexibility and greater ease of control."

Crane Builder "J": "With the class of apparatus which we manufacture we find the induction motor meets every condition quite as well as the direct-current motor."

Crane Builder "K": "You have the advantage of the series-wound crane motor speeding up on direct current which you do not have on alternating current. That is, with a full-load speed of 20 ft. per minute the low-load speed would be about 45 ft. per minute. If you were using alternating current the full and low-load speed would be the same."

Crane Builder "L": "It has been proposed by some users of alternating-current cranes to install permanent resistance in series with the secondaries of the motors, so that the speed would drop off materially under load and speed up under light load. This, however, involves considerably increased motor capacities at increased price and much lower operating efficiencies, and represents merely the case of desperation to approximate direct-current crane operating conditions. Other plans have been suggested to accomplish the same result, but the fact remains that the inherent characteristics of the motors in this particular regard are less favorable in alternating-current than in direct-current installations."

"M": "There is a general impression throughout the trade that cranes, especially for foundry service, cannot be operated as well with alternating-current motors as with direct current, This impression was prevalent among some of the engineers when the time came for a decision for the type of crane to be installed in our new works. As a result a committee was appointed, of which I was a member, which conducted very extensive tests on cranes in our works and demonstrated beyond the question of a doubt that just as delicate control could be obtained by the alternating-current crane as by the direct-current. As an example of this, we took a 5-ton load on an overhead traveling crane and were able to hoist and lower by increments of 1/16 in. and travel and trolley about ⅛ in. The load was then changed to 50 lb. with practically the same results.

"The policy of our company as regards the choice of alternating current versus direct current depends on the original supply of current. If the original supply of current which you are to use in the foundry is alternating current, do not change to direct current for your cranes. If it is direct current, do not change to alternating current for your cranes.

"There is, however, one inherent advantage in the alternating-current motor for crane work which cannot be obtained from direct current, and we have had cause many times in our works to notice this. Where the cranes in our foundry are direct current if the craneman is trying to pull a very heavy casting from the sand and it is not properly loosened up he will invariably plug or hold his breaker if he is not able to pull the casting from the sand with the ordinary setting of the breaker. This in several instances has caused serious breakages of chains and gearing on the cranes. This, of course, would be impossible with an alternating-current motor of the proper size. Regardless of whether he had his breakers plugged or there were none, the alternating-current motor would fail after a certain torque was reached and more current sent through it. This, however, is not true in machine shops in general, as no piece goes into the machine shop which cannot be handled."

CONCLUSIONS.

By consulting the table on the following page it will be seen that under the headings "Reliability" and "Efficiency" favor appears to be about equally divided. First cost, maintenance, and speed and accuracy of control are the more important consider-

[2]The extracts under "M" are quoted from the opinion of the manufacturer referred to, in reply to an inquiry as to the considerations which led to the adoption of alternating-current equipments.

ations involved in the selection of crane equipment, and, from the standpoint of the crane builders, favor is decidedly on the side of the direct-current equipment, especially as regards the most important feature, speed and accuracy of control.

It is fair to assume that a slight prejudice against alternating-current equipment exists among crane builders for the reason

RÉSUMÉ OF OPINIONS.

Crane Builder.	Reliability.	Lowest First Cost.	Lowest Upkeep and Maintenance.	Efficiency.	Speed and Accuracy of Control.
A		D.C.		A.C.	D.C.
B		D.C.		D.C.	D.C.
C	A.C.	D.C.	A.C.		D.C.
D	A.C.	D.C.			D.C.
E	A.C.	D.C.	A.C.		D.C.
F	A.C.	D.C.	A.C.	D.C.	D.C.
G	D.C.	D.C.	A.C.	D.C.	D.C.
H	D.C.	D.C.	D.C.	D.C.	D.C.
I		D.C.	A.C.	A.C.	D.C.
J			A.C.		
K		D.C.	A.C.		D.C.
L					D.C.
	2 D.C.	10 D.C.	1 D.C.	4 D.C.	11 D.C.
	4 A.C.		7 A.C.	2 A.C.	
	6 no choice	2 no choice	4 no choice	6 no choice	1 no choice

Total: 28 for direct current; 13 for alternating current; 19 no choice.

expressed by builder "E" under "First Cost"—that is, there are only two American firms which regularly furnish alternating-current crane equipments. Several crane builders manufacture their own direct-current crane equipments.

Having in mind the foregoing, the following conclusions appear logical:

(a) Where the current supply to a shop is direct current the crane equipments of that shop will naturally be direct current.

(b) Where the current supply is alternating current and additional motor-generator or converter capacity would be required for direct-current cranes judgment should be guided by the considerations set forth by crane builder "B" under "First Cost."

(c) Where speed is of importance and the loads to be handled vary widely in weight, the majority being small compared with the crane capacity, direct-current equipment should be selected.

(d) Where delicacy is of importance direct-current cranes have established their effectiveness. Manufacturer "M" produces evidence of satisfactory delicacy and control having been obtained with alternating-current cranes. This is a matter of controlling appliances more than anything else, and although direct-current crane-controlling appliances are undoubtely more fully developed than alternating-current appliances, if the desirable degree of control is guaranteed by the manufacturers of alternating-current controlling appliances, the alternating-current equipment should receive equally favorable consideration as regards delicacy.

(e) If the source of current supply to the shop is alternating current and the loads are intermittent and relatively heavy, there appears no reason why alternating-current cranes should not be installed. The motors, however, should be carefully selected as regards capacity, so that their maximum torque will be ample for handling the heaviest loads.

Central Station
Management, Policies and Commercial Methods

COMBINATION ELECTRIC-LIGHT PLANT AND CREAMERY.

A plant recently started at O'Neill, Neb., by the O'Neill Light & Power Company carries on the unique combination of an electric light and motor and a creamery business. The combination of these two industries made it possible to install an electric-light plant where otherwise the enterprise would be of a doubtful financial character. The motive power is a Murray 45-hp Corliss engine belted to a line shaft. From this line shaft is driven a 50-kw, three-phase, 2300-volt alternator at 900 r.p.m. For the creamery business there is belted to the line shaft a 10-ton DeKalb refrigerating machine, made by the Creamery Package Company. The other machinery for the butter and ice-cream making is also driven by the line shaft. The establishment has a capacity of one car of butter per week and 300 gal. of ice cream per day. Provision is made for adding another unit as the business grows. The engineering features were worked out by Mr. B. C. Adams, general manager of the Lincoln Gas & Electric Company, of Lincoln, Neb. The officers of the O'Neill Light & Power Company are Mr. R. W. McGinnis, president, and Mr. A. A. Driggs, secretary and treasurer, both of Lincoln, Neb. Mr. H. R. Holdeman is superintendent of the electrical plant.

WOOD MILL USING CENTRAL-STATION DRIVE SELLS REFUSE AT PROFIT.

A large stave mill at Galveston, Tex., which formerly burned its refuse in its own 100-hp isolated steam plant, is now operated by 40 hp in electric motors using central-station service. This motor drive costs the mill $60 to $65 a month at 4 cents per kw-hour, while it sells the refuse formerly burned to the local gas company for $1.15 per ton delivered, or about $150 per month. The gas company utilizes the oak shavings and refuse for fuel in its water-gas plant, replacing oil that formerly cost $400 to $500 a month. A ton of the oak fuel, reports Mr. F. M. Lege, manager of the local company, is equivalent to about 4 bbl. of oil. Special furnace settings had to be designed to burn the wood to the best advantage, but the existing boiler equipment was converted for the purpose at very slight cost. The wood mill finds the new arrangement very satisfactory as it saves both cost and labor, and the gas company has been able to cut its fuel cost considerably. The figures above given for the stave mill's saving do not adequately represent the entire economy gained by the customer, for he has since added several machines.

Several other wood-mill customers of the Brush Electric Light & Power Company, of Galveston, also report substantial savings in replacing steam by electric power. One such mill, which formerly burned all its refuse besides $100 worth of coal per month, now pays $80 a month for electric service to its 100 hp in motors, sells its by-products for $100 and saves the entire cost of its coal, netting an economy of about $120 a month.

DEMONSTRATION BY MODEL OF ELECTRIC SERVICE IN DENVER.

At a recent meeting of the N. E. L. A. company section of the Denver Gas & Electric Company Mr. H. S. Russell, one of the electrical engineers of the company, gave a demonstration, by the aid of a model, to illustrate the salient features of the generation and distribution of electrical energy as exemplified by the Denver company's system.

Simple forms of apparatus were used. The hydroelectric system of the Central Colorado Power Company was represented by a water motor driving a small alternating-current generator, the energy from which, by three transformations, was delivered to the buses of the West Side station of the Denver company. To represent one of the three steam-generating stations of the company a small steam engine driving an

alternating-current generator was used, the output of this unit being also delivered to the buses. Direct current was generated by means of motor-generator sets, a belt-driven combination being used to represent this type. A sectional model of the modern steam boiler was employed to illustrate the construction and operation of steam-raising apparatus.

From the alternating-current and direct-current buses circuits were run out to represent the distribution of the following classes of service: Single-phase current for lighting, three-phase current for motors, direct current for motors, and a transmission line to neighboring towns for lighting and motor purposes.

The idea of demonstrating by this ocular means the manner in which the company serves its customers proved very attractive to the members of the section, and the demonstration was viewed with much interest. At further meetings the distribution of gas and electricity will be taken up in greater detail, using miniature apparatus for the purpose.

SALE OF ELECTRICITY BY ELECTRIC RAILWAYS.

In the discussion following the presentation of a paper on "Development of the Auxiliary Load for Railway Power Plants," by Mr. J. C. Young, Cedar Rapids & Iowa City Railway & Light Company, read at the recent Iowa street-railway convention, Mr. Mathes, of Dubuque, noted that the general trend nowadays is for electric railways to increase their revenue in any possible way and for this reason many roads had undertaken to sell energy from the trolley wires or transmission line.

Mr. Crafts, of Clinton, said that the Iowa & Illinois Railway a few years ago undertook the sale of energy. The tendency then was to sell 500-volt energy from the trolley wire and to have the purchaser build his line to the right-of-way fence, where protective devices were installed. Mr. Crafts criticised this plan because the expense for fuses, burned meters and upkeep overbalanced the profits from the sale of the energy. He now has two direct-current motor customers, one with a 5-hp motor and the other with a 50-hp motor. The former installation is located near a carhouse and the latter near a substation, so that the cost for attendance to the customer's service line and connection is not unduly large.

At Princeton Mr. Crafts' company is furnishing energy for a circuit of 40-watt series-tungsten street lamps. In addition another installation has been made recently at a large country residence. Energy here is furnished for motors having a total rating of 40 hp and 500 lamps, all operated by alternating current transmitted at 2200 volts. The supply is taken from the secondary side of the substation transformers at 360 volts and stepped up for transmission. Energy is sold at the rates established by the lighting company in Davenport. Mr. Crafts doubted the advisability of connecting a large number of motor customers directly to the trolley line because railroad service might thus be hampered. On the other hand, however, if the motor load were large enough a maintenance man might be employed and thus the possibility of interference greatly reduced.

Mr. Frank McDonald, of Waterloo, said that the Waterloo, Cedar Falls & Northern when first started had some direct-current motor customers. The business was not found profitable, however, and so it was turned over to the local electrical company. To-day, however, the road is considering the sale of energy along its interurban line to those towns in which substations are located.

Mr. Charles Munson, electrical engineer of the Cedar Rapids & Iowa City Railway & Light Company, said that his motor customers receiving direct-current service had not caused any line trouble. Heavy fuses are put at the line connection close to the lightning arresters, and lighter fuses, which can be replaced by the customer, are placed at the motors.

Mr. Mathes told of some motor-service supply furnished from a suburban trolley line extending to his company's railway park. One customer is a dairy establishment using a 10-hp motor to operate a machine for milking cows. The revenue from this customer averages from $35 to $40 a month. Other customers on the trolley line have installed 5-hp motors for sawing wood. The gross revenue from the sale of energy along this suburban trolley line is about $900 a year, and regular city rates are charged.

COMMONWEALTH EDISON COMPANY SECTION N. E. L. A.

At the meeting of the Commonwealth Edison Section of the National Electric Light Association in Chicago on June 13 Chairman E. F. Smith announced that the membership had now reached a total of 1188, which is the largest of any individual company section in the association. Mr. John F. Gilchrist, the new president of the N. E. L. A., gave an interesting address on the mercantile business of the company. He also described in a few words the benefits of the employees' savings fund. Employees of the company may invest in this fund. By allowing their savings to accumulate for a term of five years the principal and accrued interest compounded at 6 per cent may be invested in the company's stock at par. Inasmuch as this stock is now selling on the market at about 128 and 129 the result for the five-year period is a very fine investment for the employees, and will net approximately 16 per cent to 20 per cent a year provided the stock is selling at the end of the period at about the present market price.

Mr. Gilchrist made an earnest plea for the support by the section during the coming year of the association's activity. The Commonwealth Section has been honored by the promotion of one of its members to the presidency of the national association, and, therefore, has an added responsibility. The greatest value of the N. E. L. A. perhaps is its influence on the individuals comprising the association. It engenders enthusiasm which is of incalculable benefit both to the N. E. L. A. and to the member companies which control it. Mr. Gilchrist's appearance on the platform and his address were received with enthusiastic applause.

Brief reports from the recent New York convention were presented by Messrs. E. W. Goedjen, G. A. Freeman, Joseph H. Perry, John C. Johnson, E. A. Edkins, R. F. Schuchardt and E. W. Lloyd. The last-named speaker called particular attention to the great value of the papers and reports read at the New York convention, and the fact that only a few members of the section had obtained opportunity to read and assimilate them as yet. In order that greater benefit may be obtained from these papers, Mr. Lloyd announced that several of the departments of the company would hold meetings in the future at which convention papers pertaining to the work of that department would be abstracted and discussed.

A pleasant feature of the evening was the presentation by Mr. Peter Junkersfeld of gold-button badges to Messrs. George H. Jones, J. C. Manley and Ernest F. Smith, who have served as chairmen of the section. Resolutions of condolence on the death of Mr. Robert D. Ferguson were adopted. The meeting was concluded by some excellent music given by the N. E. L. A. orchestra of the section.

EFFECT OF BRONZE AND PAINT ON RADIATOR EFFICIENCY.

Without doubt the worst kinds of coatings that can be applied to radiators are the familiar aluminum and copper bronzes so generally used, according to the results of tests made at the University of Michigan and reported by Prof. J. R. Allen, of that institution, to the National District Steam Association at its Pittsburgh convention, June 6.

In these investigations use was made of two radiators exactly alike, which in their unpainted condition fresh from the factory showed practically the same condensation. One radiator was

then painted with two coats of copper bronze and was found to have its heat radiation diminished by 24 per cent below that of the original cast iron. Another pair of copper bronze coats decreased the radiation by 25 per cent. Two coats of terra-cotta enamel were then brushed over the existing four coats of bronze, with the result that the heat transmission became even 3 per cent better than with the original unpainted cast iron. The results of applying fourteen other coats are shown in the accompanying table, the procedure being terminated by adding two final coats of aluminum bronze, when the radiation again promptly fell to 73 per cent of its former value. Other tests with enamels, japans, and lead and zinc paints are shown in the last six lines of the table.

Surface.	Room Temperature.	Temperature of Steam.	Condensation in Pounds.	Radiation in B.T.U.	Efficacy.
Plain cast iron	74.4	222	.413	2.82	.997
Plain cast iron	76.0	220	.418	2.94	1.005
Copper bronze	63.1	224	.353	2.16	.761
Copper bronze (Two Coats)	72.3	220	.325	2.08	.752
Terra-cotta enamel (Two Coats)	74.5	220	.436	2.86	1.038
Copper bronze (Two Coats)	66.3	218	.351	2.24	.735
Light-brown varnish (Two Coats)	74.1	224	.421	2.67	.977
Oak-brown varnish (Two Coats)	72.9	226	.431	2.67	.977
Aluminum bronze (Two Coats)	71.8	225	.318	1.97	.730
Aluminum bronze	70.5	224	.324	2.005	.724
Silver-gray enamel	66.7	223	.442	2.68	.970
Snow-white enamel	67.6	224	.452	2.75	1.01
Bronze-green enamel	64.2	224	.446	2.66	.997
No-luster green enamel	64.0	224	.429	2.545	.956
Maroon gloss Japan	70.6	224	.423	2.62	.997
Shellac and copper bronze	68.5	224	.364	2.22	.850
Linseed and copper bronze	67.0	224	.347	2.02	.760
White paint	86.9	224	.379	2.62	.987
Terra-cotta paint	83.4	224	.389	2.65	1.00
Light-green paint	86.8	224	.374	2.59	.989
Light-green paint, zinc	77.2	224	.423	2.72	1.00
Terra-cotta paint, zinc	77.7	224	.408	2.66	.964
White paint, zinc	76.0	224	.418	2.70	1.01

The condensation and b.t.u. radiation in the above table are expressed in terms of hours and square feet of actual surface.

In general the table shows that aluminum, copper and metal pigments in the bronzes reduce the heat radiation. This is probably largely due to the composition of the bronze and partly to the vehicle which contains this pigment. Enamel, lead paints and zinc paints show almost no loss in heat radiation. The experiments demonstrate that the effect is largely surface effect and not conduction effect. The results show that the loss of heat from radiators depends largely upon the surface effect and to only a small extent upon the conduction of heat through the metals.

Experiments conducted with radiators of the same shape made of different materials, cast iron, wrought iron and copper, do not show a material difference in the heat radiation when painted with similar coatings of paint. This is due to the fact that the total heat radiation is determined by the region of greatest resistance to the transmission of heat. This point is at the surface, so that the material of which the radiator is made (which is always a good conductor) has very little effect. For the same reason the thickness of the metal composing the radiator has very little effect.

INDUSTRIAL ELECTRIC HEATING.

In a paper on industrial heating loads before the Iowa Electrical Association at Davenport, Mr. J. D. A. Cross, of the General Electric Company, Chicago, predicted that, encouraged by favorable rates, industrial applications of electric heat will eventually form a large factor in "off-peak" loads. There are many commercial processes requiring an even, accurately controlled temperature, together with safety. All hotels should take up the electric percolator, chafing dish and table toaster for the dining-room and the six-slice toaster for the kitchen. The proprietor of a hotel in Pittsfield, Mass., writes that it cost him from 30 cents to 35 cents per day to run his gas toaster. It costs only 10 cents to run the electric. The latter is cleaner, handier and 60 per cent faster than the gas. The above figures were based on $1.50 gas and electricity at 4 cents. The six-slice toaster takes 3500 watts a minute or 10 watts per slice. In view of its economy to the consumer on the one hand and its income to the central station on the other, an electric toaster should be placed in every hotel and restaurant. An electric broiler of the overhead radiant type has been brought out in different sizes, in which open coils of "calorite" are supported in channels of white enamel steel. The broiler pan rests upon a vertically adjustable shelf. It is worth much to have a broiler available which can be heated up instantly. Electric ranges are now available in large sectional units to displace the hotel coal or gas range. Tests on these in the United States Navy showed that electricity is somewhat cheaper than coal and the output of food with a given size of electric range is greater. This electric range has been standardized in the navy for use in ships' galleys.

Bake ovens of sixty-four-loaf and ninety-six-loaf capacity are now available and have also been standardized by the United States Navy. The electric baking can be done at the rate of fifteen 1-lb. loaves per kw-hour, or 0.2 cent per loaf at a 3-cent rate.

A laundry flatiron uses three or four kw-hours per day. In the laundry high temperature devices using steam and gas may be displaced by electricity, but low-pressure steam will usually be able to maintain its ground for drying and mangling. The following data relate to a Sikeston (Mo.) electric laundry:

The bill for this laundry amounts to $35 per month at a 3-cent rate, the energy consumption being about 1160 kw-hours. This laundry has ten employees and an income of about $780 per month. The electric-heating equipment consists of one combination bosom and body ironer, one neckband and wrist ironer, one collar shaper and several flatirons. A 5-hp motor drives the ironer and shaper and in addition three washing machines, one starcher, one wringer and one steam mangle. The mangle and the dryroom are supplied with low-pressure steam. The power consumption of the laundry rolls used in the ironers is designed on the basis of 5 watts or 6 watts per square inch surface of the rolls. The introduction of electricity in this laundry has resulted in a notable improvement in appearance and sanitary conditions, increased output and quality of work and in lessened fire risk and greater contentment of the employees. In the printing trade the author called attention to possible load from electric glue pots, embossing machines, stereotype melting kettles and matrix dryers. Glue pots are also used in the wood-working trade. In the metal trade there are saddling irons, oil tempering baths and ovens.

DISCUSSION.

Mr. George S. Carson, of Iowa City, said he had found but a limited number of places where industrial electric-heating appliances were needed, but where he had placed them on trial they usually remained in service.

Mr. Young, of Cedar Rapids, reported 150 disk stoves on his lines for various purposes.

Mr. H. C. Blackwell, of Davenport, had been introducing electric flatirons, but said that other devices moved very slowly. After trying to sell them from the company's salesrooms he then tried department and jewelry stores, but without success. He felt the devices were all right, but he had not discovered the way to place them. Nevertheless his customers would go to the electrical shop in Chicago and make such purchases. About 15 per cent of the consumers have electric flatirons.

Mr. P. B. Sawyer, of Des Moines, said his company had adopted the practice of repairing irons free for consumers in order to keep them in regular service. Mr. Young, of Cedar Rapids, reported having 120 electric irons among 180 residence customers. Mr. Cross told of a plan worked by the Milwaukee Electric Railway & Light Company of sending out 1000 electric irons by telegraph messengers. These irons were delivered without note or comment and a day later a letter was sent by the company saying that the iron was sent for trial.

GENERAL-UTILITY MOTOR IN THE HOUSEHOLD.

At the Nebraska Electrical Association convention recently held at Lincoln, Neb., Mr. S. G. Peticolas gave a paper dealing especially with small motors for general household uses. He showed a small portable motor provided with several attachments and intended for many different uses. There has been a great demand for this motor on account of the various uses to which it can be put. It is made in both alternating-current and direct-current types. The Westinghouse company has given the motor wide publicity through popular advertisements and the distribution of literature. Its particular field is to create in the mind of the user a desire for small units for a variety of service. The blower attachment suggests the desirable possibility of ventilation, obtaining fresh air and getting rid of foul air. The buffing and grinding attachment shows how desirable a motor would be for that service alone. The use of the general-utility motor demonstrates the usefulness of a little larger motor to operate the washing machine. The general-utility motor is, therefore, intended as an entering wedge by which to demonstrate to the user the advantages and possibilities of electric drive in the various household arrangements.

DISCUSSION.

The discussion centered mainly on the question of how such devices should be handled, whether by the central-station company or supply dealers exclusively. Mr. J. E. Schuff, of Lincoln, said that the various vacuum-cleaner companies and washing-machine companies had agents in Lincoln, and hence his company, the Lincoln Gas & Electric Company, did not attempt to handle these machines.

Mr. E. V. Capps, of Beatrice, said that at Beatrice this business had been turned over to the supply men. Imperfectly developed devices are likely to make trouble if introduced by the central-station company. Mr. Schuff reported that fifty or sixty vacuum cleaners had been put out in Lincoln by one company.

Mr. J. G. Boyd said that the central-station company should not divide the responsibility of putting these devices out. If a supply dealer puts out a piece of apparatus with which the consumer has trouble and the consumer comes to the central station, it is little comfort to the consumer to be told that he must go to the company which sold the device.

Mr. S. F. Dibble thought it a mistake for the central-station company to evade the responsibility of handling new appliances. The dealer cannot afford to follow up and spend much time on the prospects which are the most difficult to get, but which may be the most desirable for the central station. The central station, on the other hand, can afford to follow these up. The central stations which are pushing the various devices are doing the most business, but co-operation between the central station and the dealer is the best policy. In many communities the motors which are the easiest to sell, such as those used on very intermittent service, have already been sold, leaving the factory installation to be worked up by the central-station company.

Mr. A. L. Pond told of a test on the value of wood refuse obtained from a wood-working plant for fuel. The net result was that between 5 tons and 6 tons of shavings were required to equal 1 ton of coal when the shavings were hand-fired and from 4.5 tons to 5 tons of shavings when the shavings were blown in. In regard to placing motor installations on free trial in order to secure business, he warned managers that when so placed the motors were likely to be used rather wastefully in order to determine the maximum bill that could be run up with the new method of driving. The result was an excessive bill the first month. He admitted, however, that the plan frequently worked well.

Mr. T. O. Kennedy, of Lincoln, said that the central-station man had better watch the trial installation the first month to see that it is being used in the ordinary manner.

Mr. F. H. Brooks, of Lincoln, thought that large power propositions should be handled mainly by the company rather than the dealer. However, small devices are in another field, which he thought best to let remain with the supply dealer, but it is necessary for the central station to do considerable pioneer work to create demand. Once the sales are started the dealers can take care of the business.

Mr. C. C. Smith, of Exeter, said that his town was so small that no reliable supply man could live. As a result if supply business was not done by the central station it would be done by hardware stores, which would handle devices as a side issue.

A CENTRAL-STATION'S EXHIBIT-ROOM IN A DEPARTMENT STORE.

The Kentucky Electric Company maintains only a business office at its building at 219 Washington Street, Louisville, but has recently arranged an appliance display window in a new department store on the principal shopping street of the city. The central-station company obtains this window space as well as a demonstration counter within the store rent free from the store owner, who gets his return from the presence of persons attracted into his establishment by the electrical demonstrations, and has willingly given up the largest part of one of his two show windows for this purpose. Electric heating and cooking appliances, fans, etc., are shown in the street window, and practical demonstrations of their use are given at the counter inside. The central-station company has its own service lines for its exhibit, but makes no payment to the department store for the space occupied. Invitations to visit the demonstration are run in the display-advertising columns of the local newspapers and have already done much to popularize the new store.

The Kentucky company has the services of a capable demonstrator who is qualified to discuss electric-appliance advantages with the class of people who make use of such conveniences. From her own experience and that of friends who have used certain devices this demonstrator is able to discuss the practical possibilities of the apparatus, explaining, for example, how an entire chicken dinner can be cooked on a 500-watt toaster stove, and give other points that instil confidence in the use of the apparatus into her women customers. The experience of the Louisville company has shown that a professional demonstrator is not so much needed as one combining tact with a knowledge of the community in which she works. Good results have also been obtained from a telephone invitational campaign carried out by this demonstrator. A selected list of probable appliance users is compiled, and the demonstrator, who is familiar with local people, calls up these persons, inviting them in the name of the company to visit the demonstration booth and to try certain appliances in which she thinks they may be interested. Knowing something about the individual called, she is able without disclosing her own identity to add personal touches that invariably bring a pleasant acknowledgment of the invitation and "Thank you" from the other end of the wire and leave a definite impression which no other kind of advertising could create.

AN ALL-ELECTRIC BAKESHOP IN MUSKOGEE.

The use of electric motors in bakeshops is no longer unusual in the case of the drive of individual machines, such as dough-mixers, cake-mixers, ovens or the like. By installing such motor-driven machines even conservative practical bakers admit that they can often replace the wages of a high-priced man by the nominal monthly bill of the electric company. Bakery-machine manufacturers, however, have already applied the electric motor to every conceivable power-consuming operation in the production of breadstuffs, so that the food need not be touched from the time it is unbarreled into the flour bins until it comes fresh and crisp from the ovens.

One of these all-electrically operated bakeries is at Muskogee, Okla., where a total of 13 hp in motors is installed, with an average consumption of from 1500 kw-hours to 2000 kw-

hours per month. This bakery has a maximum productive capacity of 40,000 loaves of bread per day, although, being new in the community, it has never yet been put to its full rated output.

The flour is lifted from a hopper in the basement of the building by means of the inclosed-bucket conveyor seen in the background of the picture, Fig. 1. From this it is discharged into a screw conveyor dumping into the funnel-shaped hopper shown. This hopper is mounted on a scale beam so that its contents can be weighed from the floor. The hopper discharges the flour into the three-barrel dough mixer beneath, which is driven by the same 5-hp electric motor as the flour lifter and conveyor above mentioned. A graduated tank is mounted over the hopper, from which measured quantities of water can be drawn for making up the dough batches in the motor-driven mixer. After the ingredients of the dough are thoroughly incorporated in the mixer, the latter is turned over and its contents emptied into the roller-mounted rising pans. After the dough has risen properly in these it is fed into the hopper of the loaf molder, operated by a 2-hp motor. This molder comprises a cylinder in the surface of which are cut two pairs of depressions, each the size of a dough loaf. By means of a scale and handwheel the depth of these loaf molds can be set to produce any desired weight of loaf. After the dough has been pressed into the molds on the hopper side, the cylinder is given a rapid half-rotation and the dough loaves are discharged onto a slowly moving belt, being meanwhile sprinkled with a little parting flour. The travel on the conveyor belt gives the dough loaves time to recover from their compression in the molder and by the time they have reached the far end of the long table they are ready for the 2-hp motor-driven rolling machine, where they are rolled by a large wheel around an outer casing emerging ready for the oven pans. The 700-loaf revolving oven, Fig. 2, is operated by a 2-hp motor, but, of course, is heated by gas.

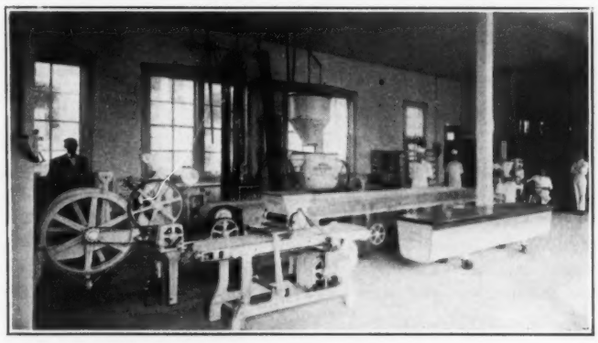


Fig. 1.—Motor-Driven Flour Conveyors, Dough-Mixers, Loaf-Molder, Dough-Breaker, etc.

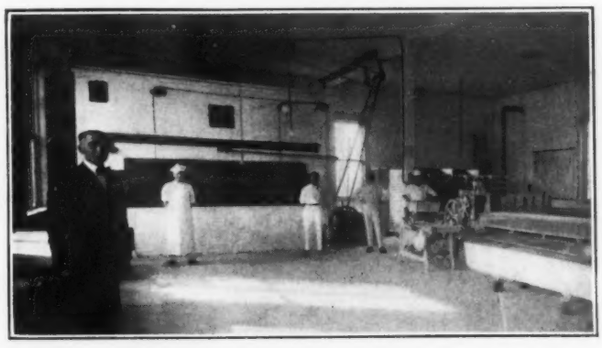


Fig. 2.—Motor-Operated Bread Oven in Muskogee Bake Shop.

In addition to the apparatus above mentioned there is also a 1-hp motor-driven egg-beater and a 1-hp motor-driven cake machine used in the production of other bakery goods. The electricity for light and motor service in this modern bakeshop is supplied by the Muskogee Gas & Electric Company.

Wiring and Illumination

PHOTOMETRY AND PHOTOGRAPHY.

By James L. Parton.

It is interesting to notice how closely allied are many of the researches conducted by photographers and illuminating engineers. The same problems are constantly being studied, often from a somewhat different point of view, it is true, but with similar results, by workers in both fields. Many of the early photographic experimenters, for example, were interested in the variations of daylight under different climatic conditions and during various times of the day, and they made actual measurements of the intensity of daylight in order to determine the probable exposure required under different conditions. Their results are surprisingly similar in some instances to those obtained by illuminating engineers who were interested in the same problem, but mainly from the standpoint of the daylight illumination of schoolrooms and other places of a similar nature.

Especially in the early stages of experience in photometrical processes, photography has often suggested itself as a means of measuring light. To some people the blackening of a piece of sensitive paper has seemed a more tangible method of studying light variations than a purely comparative method. For example, before convenient illumination photometers were available efforts were sometimes made to ascertain the distribution of illumination in a room by exposing sheets of sensitive paper in different portions and subsequently developing the whole series under identical conditions. Even recently the method has seemed to have advantages for special researches. For example, Messrs. Ives and Coblentz have used it with effect in their researches on firefly radiation. In a recent number of the *Physical Review* Mr. Charles F. Brush described a method of ascertaining small changes of illumination by photographic means. It appears to have proved, with care, a comparatively delicate means of measurement since a change in intensity of under 1 per cent is stated to have been discernible. One interesting feature was the effect of temperature, a change of only 2 deg. C. being apparently influential in affecting the final photograph.

Theoretically it is conceivable that it might be possible to exhibit on a photograph a change in tone which the eye could not detect. It is known that the sharpness of contrast in light and shade is very much affected by slight alterations in the conditions of development. By selecting the ideal conditions to make such contrasts appear well marked who can say what degrees of sensitiveness might not be attained? In short, for very refined researches photography might be a useful weapon in enabling one to detect small changes which would be allowed to pass unperceived on any photometric instrument. Against this is to be set the fact that the process is necessarily tedious and complicated compared with a measurement by means of a photometer, the subsequent development of plates, etc., taking a good deal of time.

There is, however, another quite different aspect of the subject to be borne in mind, namely, the assistance of photometry to photographers. This is the converse of the problem referred to above. Granted that photography may be of only limited service to an expert in photometry, may not measurements with photometric apparatus be of great value to the photographer?

This question was discussed in a recent paper read before the Royal Photographical Society of London by Messrs. J. S. Dow and V. H. Mackinney in which the value of photometric measurements of the actual surface-brightness of surrounding objects was touched upon. The experiments described were carried out with the holophane lumeter, a small photometrical instrument devised by the authors for measuring illumination and surface brightness.

The photographer, in judging exposure, is guided very largely by past experience, and a skilled expert learns in time to allow for variations in climatic conditions with great accuracy. This judgment, however, is attained only slowly by the novice, who has sometimes recourse to exposure tables in which the presumed variation in intensity of daylight at different hours in the day and at various times in the year is calculated. But actual measurements of daylight illumination show that the course of affairs during any day taken at random may be utterly different from what such tables, based on the average of a large number of days, would suggest. Moreover, they take no account of the variations in light and shade in the picture, the reflecting power of the object, etc. The variations in light and shade are often enormous, amounting to several thousand per cent. Yet the final print cannot represent a degree of light and shade greater than 30:1. This was demonstrated by the authors by measuring in turn the surface-brightness of pure ground white celluloid and a dead-black painted card, placed side by side and exposed to the same illumination. The consequence is that it is not possible to adjust the exposure so as to show all the relative tones correctly, but it is very essential to select that time of exposure which gives, on the whole, the best result and brings out correctly those portions of the field which are most important.

Another difficulty in photography often arises from the fluctuating character of daylight. Actinometer readings, for example, take some time (in a darkish interior and by artificial light often too long to be of practical service) and the conditions may have changed radically while the test is in progress.

All these difficulties are avoided by basing the exposure on measurements of the actual surface-brightness of the objects in the field of view. Such a measurement can be taken in an instant, and one can gain information as to the comparative lightness and darkness of distant objects, in which actinometer readings would naturally not be of assistance.

However, there is one special field in which photometer readings are specially serviceable as a guide in taking photographs, namely, views of interiors lighted by artificial means. This is a matter of increasing interest to illuminating engineers. Companies concerned with the sale of lighting appliances are coming to recognize that nothing is so influential in enabling them to arouse interest as excellent photographs of well-lighted interiors. Illuminating engineers, too, know the value of good photographs as a record of good and bad installations, especially for demonstrations and in lecturing.

Yet, curiously enough, it is not often that one sees really successful views of interiors taken exclusively by the light of the actual illuminants in use and without retouching of any sort. The requirements of the illuminating engineer in this matter are not often realized by the professional photographer. For his purpose it is the nature of the lights themselves and the distribution of illumination that is important. For scientific purposes it is also often essential that the photographs should not be retouched in any way, so that they may show an absolutely faithful record of the actual conditions as seen by the eye. The exposure in such cases must, therefore, be judged with great accuracy, and this is specially important in the case of interiors in which it is desired to bring out the play of shadows and the gradation of tone by artificial light. As an illustration of this point the authors showed three photographs of a white screen illuminated respectively by a bare lamp and a lamp with a prismatic reflector, the times of exposure being different but the development and all other conditions identical. It was shown at once how easily the contrast in distribution of light was spoiled by a small error in exposure.

The painstaking illuminating engineer interested in photography of this kind usually finds that he must study the subject for himself. An outside photographer, however expert in ordinary work, rarely understands his exact requirements. During the discussion of the paper referred to Mr. T. E. Ritchie, of the Union Electric Company, exhibited a series of excellent photographs of various interiors lighted by arc lamps and taken by the aid of the holophane lumeter. A feature of these views, in addition to the wonderful clearness of detail and the gradation of tone, was the perfect definition of the arc lamps themselves, the globes of which appeared without any sign of "flare," although the photographs were not retouched in any way. The use of a surface-brightness photometer for this purpose naturally fits in with the work of the illuminating engineer, as in visiting installations he would be using it for the measurement of illumination in any case.

There is, of course, one point that must be borne in mind in this work, namely, the varying actinic value of different artificial lights. Two objects having the same surface-brightness, but illuminated respectively by an arc lamp and an incandescent lamp may naturally not require the same exposure. By the aid of a few preliminary experiments with the most common illuminants it is, however, quite easy to allow for this fact. An interesting experiment described by Messrs. Dow and Mackinney consisted in the photography of a white test-type card (under identical conditions as regards development and exposure, etc.) when illuminated successively by nine illuminants ranging from the carbon-filament lamp to daylight and the mercury-vapor quartz-tube lamp. The surface-brightnesses were identical in all cases, but yet the results were very different. The lamps studied fell into three chief groups, and it was evident that a correction factor would be needed when results obtained with widely different illuminants were being compared.

A more difficult problem, which, however, is encountered in all ordinary photography, is the fact that the sensitiveness of the photographic plate of different colors is very distinct from that of the eye. Even this, however, it was suggested, might be overcome by using a special light filter and a Wratten panchromatic plate, the sensitiveness of which throughout the spectrum resembles that of the eye quite closely. In conclusion the authors pointed out the scope for improved photometrical appliances in connection with such processes as the testing of photographic plates, the density of negatives, etc., for which somewhat crude methods are at present sometimes used.

NEW ORLEANS' STREET-SURFACE JUNCTION BOXES.

On account of the water conditions to which New Orleans is subject, all of the junction boxes in the underground section

Fig. 1—Surface Junction Box Used as Arc-Lamp Pole Base.

of the city are placed above the street level, as shown in the accompanying illustrations. Simple and ornamental cast-iron circular boxes 44 in. high and 20 in. in diameter are employed, in many instances these boxes forming the bases of arc-lamp

poles at the street intersections. In other places where simply the turret-shaped box is installed on the curb its presence is not even noticed by the majority of the people passing. When first designed it was feared that these boxes might prove objectionable in appearance, but experience has shown that they are practically unnoticed.

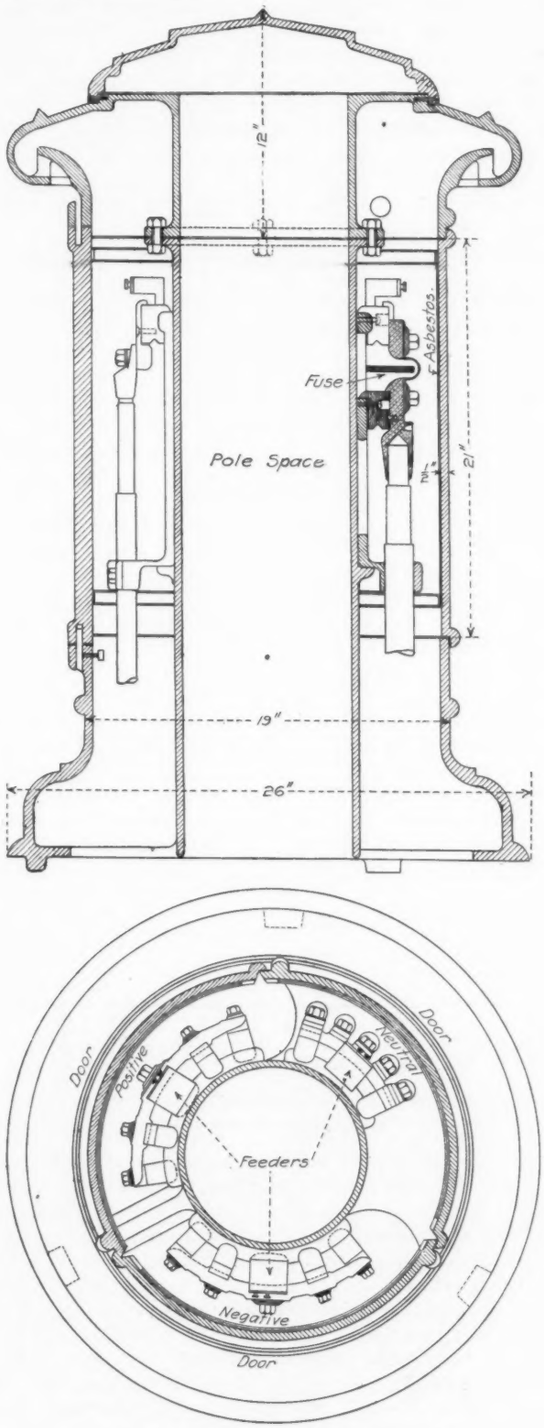


Fig. 2—Sections of Surface Junction Box.

The boxes are constructed with three 60-deg. hinged doors, which can be opened, leaving a bare skeleton framework with the electrical connections exposed. The buses are formed in arcs of circles and each has connecting lugs for the four mains and for a feeder to the middle contacts. The positive and negative sides are fused, while the neutral, recognizable by its shorter bus, is not protected.

The boxes have 26-in. bases and at their principal section are 20 in. in diameter. Where not used to inclose a pole the central space is covered by a circular cap. For use with arc-lamp poles the junction box is surmounted by an extra cut-out box for the arc-lamp circuit, as shown in the illustration. At present 136 of these surface-type junction boxes are in use in New Orleans. Several of the underground type are also employed, but the difficulty of getting at these, together with the heavy cost of replacing the rubber gaskets each time a box is opened, makes the surface type of box much more satisfactory. These street junction boxes have been used in New Orleans for a number of years, and, besides fully satisfying the requirements of local conditions, have been declared by competent distribution engineers to be admirable standard construction for use elsewhere.

LETTERS TO THE EDITOR.

Test of Gasoline Street Lamps.

To the Editor of Electrical World:

SIR:—Inasmuch as the candle-power measurements on gasoline mantel street lamps which I made in May and June, 1910, for the information of the Merriam commission (the Chicago Commission on City Expenditures) have been quoted and discussed recently at certain technical meetings, and as there appears to have been some misunderstanding, or at least a possibility of misunderstanding, as to the real significance of these tests, I wish to make a statement of certain facts in connection with them.

An account of these tests and the circumstances connected with them is given in the *Electrical World* of Aug. 18, 1910 pages 368 and 369. Rough preliminary tests were made on twenty gasoline lamps in service inclosed in the regular glass lantern or head. The average horizontal candle-power of these twenty lamps was 19.4; the minimum candle-power observed was 2 and the maximum 33. The foregoing averages do not include one lamp which was too low to read on the photometer. After these tests the company which supplies these gasoline lamps to the city of Chicago under yearly contract was notified and twelve tests were made later in the presence and with the approval of the company's expert, Mr. F. V. Westermaier. The twelve lamps so tested averaged 26.4 cp, measured horizontally with the lamp in the regular lantern, the maximum being 58.4 and the minimum 14. On this second set of tests one lamp not included in the foregoing averages was too low to read on the photometer.

As there seems to have been some controversy as to whether the candle-power measurements which were taken represented lamps that were picked out as being apparently of low candle-power or whether they represented averages as near as it was possible to obtain them, I wish to state that the lamps were not in any case selected because of apparently low candle-power, but were taken consecutively. The method employed in selecting lamps for tests was as follows: The day before each test the engineers in charge of the investigation consulted a map of the city showing the location of gasoline lamps, and selected at random without any knowledge of local conditions a locality in which a number of gasoline lamps were being operated. The locality selected was not announced until all concerned were ready to start for the place of testing that evening. Upon arriving at the locality where the testing was to be done the test was begun at a place selected at random, and from then on the lamps were tested consecutively along a street or route until the work in that locality was finished. In other words, the tests represent as near a true average as is possible from testing such a limited number. No tests have been made by the writer on the candle-power of gasoline lamps in the city of Chicago since June 23, 1910, when the last set of tests before mentioned was completed.

As a result of these candle-power investigations a new form of contract was drafted for the supply of these gasoline lamps for the year beginning Sept. 1, 1910. This contract provides for a rebate to the city if the average of 150 or more lamps tested by it each month shall fall below 45 cp. The table of rebates is as follows:

	Per Cent Rebate.
60 to 45	0
45 to 40	5
40 to 35	10
35 to 30	20
30 to 25	35
25 to 20	55
20 to 15	75
15 or below	100

It should be further explained that candle-power measurements on which rebates are based are made with the lantern door open so as to eliminate the loss of light in passing through the glass of the lantern and whatever dirt there may be on that glass. The tests on which I have quoted figures were all made with the lantern door closed. In two cases where tests were also made with the lantern door open there was an increase of about 10 per cent in light caused by opening the door. The new contract providing for 45 cp with lantern door open was drawn with the idea that 60 cp minimum with lantern closed would be a commercial impossibility with the present equipment, a point which was virtually agreed upon both by all the engineers connected with this investigation and by the gasoline-lighting contractors.

Since the present contract has been in force under which provisions are made for testing and rebates, I am informed by Mr. E. M. Tompkins, chief electrical engineer of the electrical department of the city of Chicago (under which department all street lighting comes) that the lamps tested each month average from 58 cp to 60 cp. Readings are occasionally obtained as high as 80 cp. The difference from previous results was brought about by more intelligent maintenance, and those living in gasoline-lighted districts do not need any photometric results to tell them that there has been great improvement.

Chicago, Ill. J. R. Cravath.

The Tungsten vs. the Flaming-Arc Lamp.

To the Editor of Electrical World:

Sir:—Permit me to refer briefly to the letter of Mr. J. Gustav V. Lang in your issue of May 25. The purpose of my letter in the May 11 issue was primarily to point out the great difference which the inclusion of fixed charges and maintenance costs makes in the relative operating expense of illumination with different units. Of the light sources considered in Mr. Ladoff's article this difference was most apparent in the case of the flaming-arc and the tungsten-filament lamp, hence these units were chosen as an illustration.

The two conditions of operation given were taken as typical of industrial lighting on the one hand and lighting on commercial circuits with relatively short hours of burning on the other, and did not indicate the field of either type of lamp. Mr. Lang points out that with energy at 4 cents per kw-hour there is a saving in favor of the flaming arc. This, of course, is true if the lamps are burned 4000 hours per year, but it is rather unusual to find an energy cost of 4 cents in an industrial plant which is run all night, as 4000 hours' of lighting indicates. It will be noted that a 1000-hour year was used with the 10-cent rate. With this period of operation and a 4-cent energy rate the saving will be in favor of the tungsten-filament lamps.

Since the cost table was included merely as an illustration, it seems scarcely necessary to discuss items, such as cleaning, about which there may be some difference of opinion, but which at most would make but a minor change in the final cost ratio. However, in regard to the life of tungsten-filament lamps which I assumed, I would again call attention to the fact that this was based upon operation at low efficiency, which is most economical with energy at 2 cents per kw-hour. The manufacturers rate lamps at high, medium and low efficiencies, corresponding respectively to a life of 1000 hours, 1300 hours and 1700 hours. Most lamps are, of course, operated at high efficiency, and in giving a service figure Mr. Lang no doubt based his value of 1200 hours upon experience with such lamps. At low efficiency the life would be increased by approximately 70 per cent.

The 150-hour flaming-arc lamp was not included in Mr. Ladoff's table and was, therefore, not discussed in my letter. At the time the 1000-watt cluster was placed upon the market it was undoubtedly one of the most economical units available for the illumination of certain areas, and in many cases replaced flaming arcs with highly satisfactory results. The inclosed-flame lamp is a comparatively new unit, but if it is found that inclosing the arc does not materially reduce its candle-power and does not result in excessive depreciation in intensity between trims, this lamp will be of great value in the illumination of large areas.

Cleveland, Ohio. H. H. Magdsick.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Transformer Oil.—A. Duckham.—After introductory notes on the requirements of transformer oils the author discusses the causes of deposits or sludges and of the thickening of the oil. The causes are enumerated as follows: (a) The deposition of atmospheric dust. (b) The thickening of oil due to evaporation. (c) The action of the oil on the insulating materials and varnishes of the transformer. (d) Chemical changes in the oil. It is in the chemical changes that the author finds the explanation of the formation of the greater part of the sludges and deposits that have in the past been the cause of so much trouble. In spite of the fact that mineral oils have been looked upon as stable articles and non-saponifiable and non-oxidable, yet in view of the results of his research work he considers this to be a merely comparative statement, and that under the conditions appertaining to a transformer oxidation and consequent formation of saponifiable products and of the other oxygen compounds undoubtedly does occur. In the first place there is a constant and fairly high temperature; secondly, there is usually a space above the oil where the cables are attached to the terminals and where air can circulate, and it is well known that the presence of ozone and oxides of nitrogen is often detected here. Now, from experiments he has found that mineral oils in varying degrees, when exposed to heat and in contact with oxygen, not only rapidly darken and thicken, but do actually throw out a solid deposit in the form of an amorphous brown powder, and the action is more rapid with oxygen than it is with air and still more rapid with ozone. These are the agents which are to be combated in a transformer, and more especially as the electrostatic attraction insures any solid matter depositing on the windings. This discovery is of importance to transformer users and would at once suggest tests to which their oil should be submitted before selection. There are some oils that are affected to a very much less extent than others, and by the careful selection of the crude oil from which the transformer oils are to be distilled, and by their subsequent suitable refining, one can guarantee practical immunity from this sludge.—Lond. *Electrician*, May 19.

Induction Motors.—H. L. Smith.—A paper presented before

the Rugby Engineering Society on the mechanical design of induction motors. The author deals with the various parts of induction motors individually and discusses the points that have to be borne in mind in the mechanical design of these machines. Slot dies, punchings, base plates, shafts, end shields, bearings, belt pulleys and binding bands are all considered.—Lond. *Electrician*, May 26.

Cooling of Rotors.—A note on a recent British patent (5247, May 18, 1911) of the Siemens-Schuckert Company. In providing for the cooling of cylindrical slotted rotors the conditions for effective cooling require that the air shall be brought into as intimate contact as possible with the windings to be cooled and also that the amount of cooling air passing shall bear some relation to the heat generated at that point. Now, the heat generated in this kind of rotor is a minimum about the magnetic axis and a maximum about the axis at right angles to this, and the inventor provides ventilating ducts in close proximity to the slots, which are near the axis at right angles to the magnetic axis.—Lond. *Elec. Eng'ing*, May 25.

Single-Phase Repulsion Motor.—O. STERN.—An abstract of a thesis in which the author first subjects to harmonic analysis the fluxes produced by single-phase windings. The second part deals with the calculation of the winding-factor and the third part with the experimental determination of the field of the single-phase repulsion motor of the Deri type during operation.—*Elek. Zeit.*, May 4.

Lamps and Lighting.

Series Connection of Arc Lamps and Incandescent Lamps.—W. SCHAEFFER.—The conclusion of his paper presented before

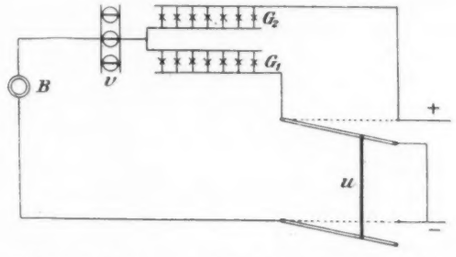


Fig. 1.—Diagram Showing Incandescent Lamps Lighted Alone.

the Berlin Electrical Society, the first part of which was recently abstracted in the Digest. With the arrangements described in the first part it was not possible to have the incandescent lamps lighted alone without the arc lamps. To make

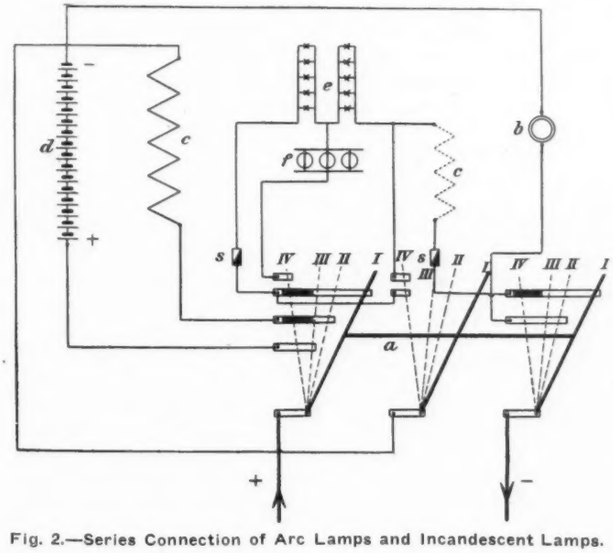


Fig. 2.—Series Connection of Arc Lamps and Incandescent Lamps.

this possible use may be made of the principle shown in Fig. 1, in which the incandescent lamps are arranged in two groups, G_1 and G_2. These two groups are in parallel with each other and are in series with the variators v (ballast resistors of Nernst lamps) and with the arc lamps B. If it is desired to use the incandescent lamps alone the two groups G_1 and G_2

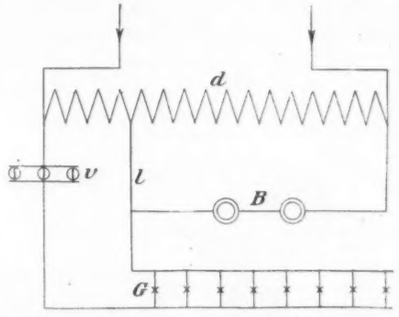


Fig. 3.—Series Connection of Arc Lamps and Incandescent Lamps on Alternating-Current Circuit.

are connected in series with each other by means of the switch u. If it is desired to use three arc lamps on a 220-volt supply it is also possible to use the incandescent lamps alone before the arc lamps are lighted. The three arc lamps consume about 130 volts. Use is made of incandescent lamps of 80 volts, again divided in two groups in parallel. As shown in Fig. 2, a three-pole switch a is used. In the position I the incandescent lamps e are lighted alone. In the position II the arc lamps b are started. In position III the battery d is connected in parallel with the arc lamp resistor c. In position IV the two groups of incandescent lamps e are connected in parallel and are connected in series with the variators f and arc lamps b, while the resistor c is disconnected. The author finally discusses the arrangement for alternating current. In this case autotransformers are employed, and the principle is clearly shown in Fig. 3 where d is the autotransformer, B the arc lamps, G the incandescent lamps and V the variators.—*Elec. Zeit.*, May 4.

Series Connection of Incandescent and Arc Lamps.—In the forty installations which have been equipped with the new system of series connection of incandescent lamps and arc lamps (see abstract above of the paper of Schaeffer) the following results have been obtained:

	For Forty Plants.	Average Per Plant.
Number of arc lamps	102	2.5
Number of incandescent lamps lighted without cost	554	14
Aggregate candle-power of incandescent lamps lighted without cost	26,710	668
Hours of burning per year	69,300	1,733
Cost of energy for the kw-hours taken from the supply lines in dollars	9,665.10	241.63
Savings against the former system in dollars	4,255.40	106.39
Percentage of savings due to incandescent lamps operated without cost	....	44%

The saving is 44 per cent of the amount paid by the plants at present for lighting.—*Elek. Zeit.*, May 18.

Electric Lighting of Motor Cars.—An illustrated description of the "Carleon" system of lighting for motor cars, the special feature of which is a generator the voltage of which is maintained constant over a wide range of speed by varying the air-gap between the armature and the field magnets. As will be seen from Fig. 4, the armature is cone-shaped and its position relative to the field magnets is adjusted by a centrifugal governor. The total travel of the armature is 1½ in. and in its limiting position each air-gap is ⅜ in. The position, however, is not likely to be reached, since at 4000 r.p.m. the armature is displaced only 1 in. The lower limit at which the armature supplies energy to the lamps or battery is 1400 r.p.m. The generator is a four-pole shunt machine, and four brushes are

used to collect the current from the commutator. Two additional brushes are attached to the end of the spindle and are displaced radially by centrifugal force when the armature is rotating, their position being controlled by two springs. Each of these brushes, which are not indicated in the diagram and which are insulated from one another, comes into contact at speeds above 1400 r.p.m. and short-circuits two insulated brass rings fixed inside the generator casing. This serves to connect the armature to the main terminals of the machine when the

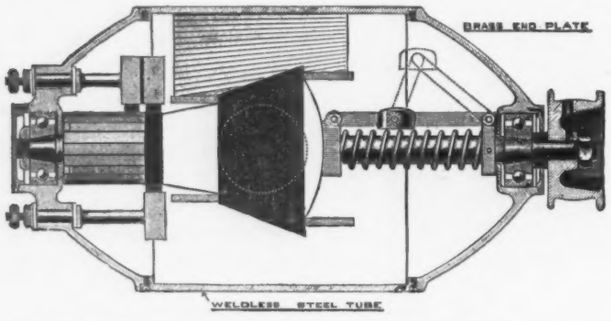


Fig. 4.—Diagram Showing Principle of Carleon Generator.

normal voltage is reached, so that a switch is unnecessary. The battery is connected permanently to the terminals of the machine, so that charging takes place whenever the generator runs at a speed higher than 1400 r.p.m., the pressure being from 14 volts to 15 volts. One set of plates consists of zinc and the other of a star-shaped carbon rod embedded in a block containing manganese peroxide, graphite, zinc chloride and sal ammoniac. These ingredients in certain proportions are made into a paste with distilled water and pressed into a block containing the star-shaped carbon at the center. The electrolyte comprises crushed oats, crushed rice, zinc chloride and sal ammoniac. The cell is therefore of the dry Leclanché type.—Lond. *Electrician*, May 26.

Photometry of Linear Sources of Light.—J. Pole.—A mathematical paper dealing with the same subject as his recent paper before the (American) Illuminating Engineering Society. The subject is discussed in the following four chapters: First, illumination produced by a linear source of light; second, photometry of linear sources of light; third, the total flux from linear sources of light, and fourth, the total flux for a concentric sphere. The paper still contains the statement that the problem of calculating the total flux from a linear source of light (in contradistinction to a point source of light) is indefinite if at the same time the surface inclosing the linear source of light and for which the flux is to be calculated is not exactly defined.—*Elek. Zeit.*, May 4.

Electric Equipment of a Theater.—D. C. M. Hume.—An article in which the author first discusses the use of electricity in a modern theater in connection with the revolving stage, panoramas, lifting stage, sliding stage, special scenic gear, mechanical flies, fireproof curtains, etc. In the second instalment the author deals with theater lighting and especially the arrangement of the switchboard and dimmers.—Lond. *Electrician*, May 19 and 26.

Generation, Transmission and Distribution.

Induction Motors for Winding Engines.—An account of the extended discussion which followed the reading of the recent paper of Mr. J. H. Heather on the driving of winding engines by induction motors.—Lond. *Electrician*, May 19.

Traction.

Electric Railways.—G. W. Kupka.—An article on the new electric railways connecting Tyrol with Bavaria. Ten thousand-volt, 15-period, single-phase current is to be used with electric locomotives. The maximum speed will be from 40 km to 45 km per hour (24 miles to 27 miles per hour); average speed, 30 km per hour (18 miles). Energy will be supplied from a hydroelectric station near Innsbruck.—*Elec. Zeit.*, May 18.

Installations, Systems and Appliances.

Electromagnetic Relays.—A note on a recent British patent (2249, May 18, 1911) of the Adams Manufacturing Company, Limited (Cutler-Hammer Manufacturing Company of this country). In alternating-current relays the windings which attract a number of cores in a longitudinal direction to actuate a pivoted switch member are by this invention made to actuate a pivoted member which carries a switch and also a number of cores. The windings are arranged on a frame of conducting material to which one terminal is connected, the other end being taken to the supply line so that each winding is connected in a different phase of the polyphase supply which energizes the relay. When an abnormal current flows in the circuit the pivoted arm is actuated to open or close the switch to control the required apparatus. The pivoted member may be abnormally held in this position, so that its contact switch engages with the stationary contacts by a tension device adjustable to vary the conditions under which the pivoted arm is actuated by the windings.—Lond. *Elec. Eng'ing*, May 25

Rates.—K. Gajczak.—The author discusses a tariff system which he formerly recommended and in which he emphasizes that central stations should arrange their charges according to the cost at which a consumer can generate energy for himself in an isolated plant. A certain fixed price is charged according to the maximum power which the consumer is permitted to take from the supply mains and another charge is made for the kw-hours consumed. The maximum power taken from the supply mains is not controlled by a maximum demand indicator, but is fixed by some limiting device which makes lamps flicker and stops the motors when the maximum permissible power is exceeded. Some figures are given on the cost of generation in stations of different sizes on which the rates should be based. He thinks that such a rate would greatly aid the development of electric cooking and heating.—*Elec. Zeit.*, May 18.

Wires, Wiring and Conduits.

Heating of Cables with Current.—S. W. Melsom and H. C. Booth.—A paper presented before the (British) Institution of Electrical Engineers. Investigations on the rise in temperature of various sizes of conductors carrying current are discussed, the effect of stranding, of installing in tubes, wood casing, etc., and of various methods of insulating and covering being described. The results of this research are incorporated in the recently issued sixth edition of the "Wiring Rules" of the (British) institution. The conditions under which the tests were made and the temperature rise was measured are described. The increase of temperature of the cables was determined by measuring the increase of conductor resistance. Fig. 5 is typical of the results obtained with different types of covering for a 7/16 cable. In general, the current-carrying capacity of rubber cables for a temperature rise of 20 deg. Fahr. is about 10 per cent less when they are run in casing than when they are laid out along the floor—that is, in air (the latter, of course, approximates to the conditions of the cables cleated to a wall or in a wood chase). There is also very little difference between the rubber-insulated and paper-insulated cables when laid under similar conditions. The difference between rubber cable in casing and in iron tube in air (that is, laid along the floor) is very small. When, however, the iron tube is embedded in plaster the cooling is distinctly better, the curve being nearly the same as that obtained with the lead-covered single cable. Other diagrams are given in which the current density is given as a function of the cross-section of the conductor for various temperature rises. In certain cases (that is, single rubber-covered cables in air and in wood casing and paper-insulated lead-covered cables, both single and concentric) the connection between cross-section and current-density could be fairly represented by a formula of the type $i = K\,(D/S)^n$, where n is a constant and K depends on the system of units adopted and the amount of the temperature rise. If i is the

current-density in amperes per square inch, S the cross-section of the copper in square inches and D the diameter of the outside covering of the cables in inches, then, for a rubber-covered cable in air, $i = 364\,(D/S)^{0.661}$; for a similar conductor in casing, $i = 309\,(D/S)^{0.66}$, and for a lead-covered cable, $i = 429\,(D/S)^{0.5}$, the temperature rise assumed in each case being 20 deg. Fahr. For a 30 deg. Fahr. rise K is 457, 358 and 536 respectively for the above three types, n being unchanged.

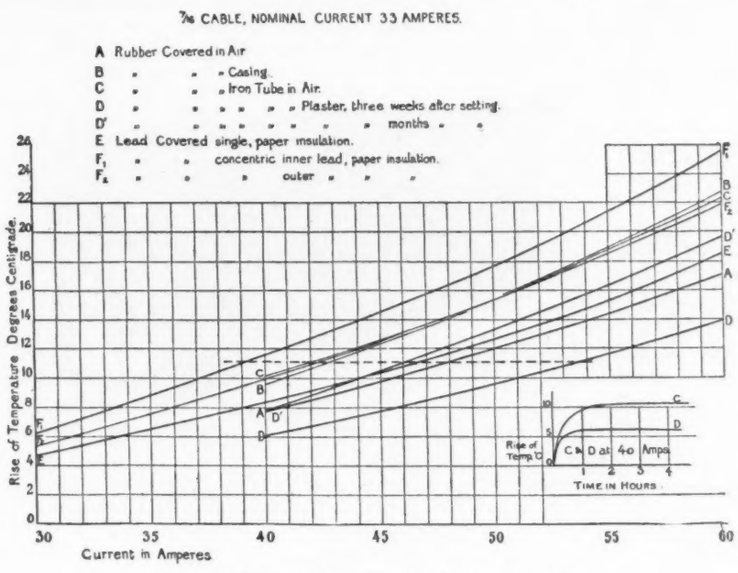

7/8 CABLE, NOMINAL CURRENT 33 AMPERES.
A Rubber Covered in Air
B " " " Casing.
C " " " Iron Tube in Air.
D " " " " " Plaster, three weeks after setting.
D' " " " " " " " months " "
E Lead Covered single, paper insulation.
F1 " " concentric inner lead, paper insulation.
F2 " " " outer " " "
Rise of Temperature Degrees Centigrade
Current in Amperes
Rise of Temp °C
C & D at 40 Amps.
TIME IN HOURS

Fig. 5.—Temperature Rise in Various Cables.

For a 50 deg. Fahr. rise $K = 688$ for a lead-covered cable.—Lond. *Electrician*, May 26.

Electrophysics and Magnetism.

Positive Atomic Charges.—So far as our knowledge extends at the present time an atom consists of a positive part (sub-atom) combined with some unknown number of electrons. The positive sub-atom is generally regarded as the strictly material part of the atom, since the atomic mass seems to be associated with it. The positive charges are generally assumed to be equal and opposite to the negative charges, but the author suggests that different sub-atoms may have different electric charges and that the electrical charge of an atom is as characteristic a physical constant as its atomic weight. He offers the hypothesis that the positive sub-atoms of the elements have characteristic charges which vary as the square roots of their atomic weights. In a second paper in the same issue he suggests that both the viscosity of gases and their solubility in water depend upon the characteristic charges carried by their molecules.—*Phys. Review*, May.

Electrified Sphere.—G. H. LIVENS.—A paper of a mathematical nature on the initial accelerated motion of a perfectly conducting electrified sphere.—*Phil. Mag.*, May.

Uranium and Radium in Minerals.—MISS R. PIRRET AND F. SODDY.—An account of further experimental investigations on the ratio between uranium and radium in different minerals.—*Phil. Mag.*, May.

Units, Measurements and Instruments.

Measuring Insulation Resistance in Networks.—L. VERAIN.—An article in which the author first shows the futility of some proposed methods of measuring the insulation resistance of direct-current three-wire networks during operation. The author then describes two methods which permit one to measure the insulation resistance of the three conductors of a three-wire network where access can be had to the generators. It is not possible to determine by this method the insulation of a three-wire network at any point, as is possible in two-wire plants.—*La Lumière Elec.*, May 6.

Meters.—An official communication by the Reichsanstalt by which a modification of the single-phase induction meter of the Siemens-Schuckert Company is admitted for calibration. The adjustment of the phase displacement is obtained no longer by branch circuits, but by a short-circuit coil which is closed by a loop of constantan wire, the resistance of the loop being variable by a sliding contact. The cores of the current coils have shoes of thin sheet iron for the purpose of mixing the current flux and the voltage flux more intimately and thereby increasing the torque.—*Elek. Zeit.*, May 4.

Exhibition of Apparatus.—J. REYVAL.—An illustrated description of the exhibits at the recent exhibition of the French Physical Society in Paris.—*La Lumière Elec.*, May 6.

Reducing Screens for Photometric Use.—H. E. IVES AND M. LUCKIESH.—A description of a new form of neutral-tint absorbing screen suitable for reducing intensities with the photometer. It is an opaque-line grating on glass, of the type used by photoengravers.—*Phys. Review*, May.

Telegraphy, Telephony and Signals.

Automatic Telephony.—A. RAPS.—A fully illustrated lecture held before the Berlin Electrical Society on automatic and semi-automatic telephony with connections up to 100,000, with special reference to the Sprowger system as modified by the Siemens & Halske Company for German conditions. The author shows that automatic telephony has many advantages in operation and permits great savings with respect to first cost as well as operation.—*Elek. Zeit.*, May 4, 11 and 18.

Printing Telegraphy.—D. MURRAY.—The conclusion of his recent paper presented before the (British) Institution of Electrical Engineers. In the present instalment illustrated descriptions are given of the Murray printing telegraphy system, especially the Murray multiplex page-printing telegraph. An account of the discussion which followed is also given.—Lond. *Electrician*, May 12.

Shock Excitation.—M. WIEN.—An illustrated review of his experiments on a new form of shock excitation using longer spark-gaps. For the purpose of obtaining a better quenching effect there are inserted in the exciting circuit Geissler tubes in addition to the spark-gap proper.—Lond. *Electrician*, May 19.

Miscellaneous.

Higher Technical Instruction.—J. H. REYNOLDS.—A paper read before the British Imperial Educational Conference. The author discusses the reasons why Great Britain is behind other countries in regard to education. In spite of the fact that facilities for higher technical instruction have been considerably increased the number of students studying science as applied to manufacturing industry is small. The author pleads especially for a keener appreciation of the value of knowledge and the subordination of the passion for games.—Lond. *Electrician*, May 19.

BOOK REVIEW.

ELEKTROTECHNISCHE WINKE FÜR ARCHITEKTEN UND HAUSBESITZER. By L. Bloch and R. Zaudy. Berlin: Julius Springer. 151 pages, 99 illus. Price, 2.80 marks.

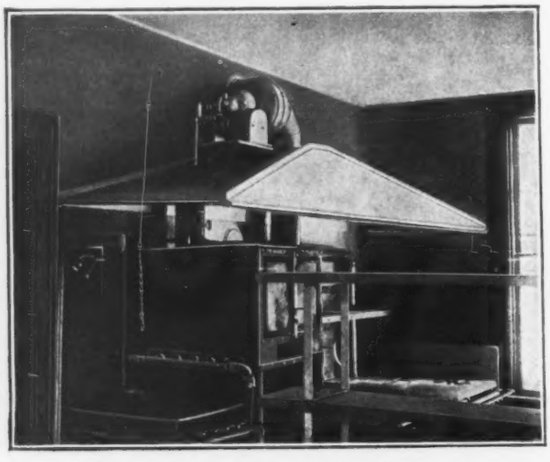
A handy elementary textbook for the use of architects and of others interested in its subject-matter on the use of electricity in buildings, how installed and how applied. The ordinary electric household appliances, such as lamps, heaters and motors, are described in non-technical language, so as to be readily understood by the uninitiated. The methods of running wires in buildings, both old and in course of erection, are explained. A final chapter is devoted to the applications of electricity in building construction. The book will be useful to architects as illustrating German practice in the use of electricity both in building and for buildings.

New Apparatus and Appliances

ELECTRIC BLOWER FAN FOR THE KITCHEN.

For carrying off the fumes from kitchens in hotels, apartment houses and institutions of various characters the method frequently adopted consists of simply placing hoods over the ranges and connecting same to the chimney (in case the flue area is large enough) or into a separate pipe up through the roof with a ventilator on top. Such a system works fairly well when there is a good circulation of air outside, but fails on a close, muggy day when kitchen ventilation and cooling are most desirable.

An outfit overcoming this difficulty is shown in the accompanying illustration. It has recently been installed in the kitchen of the Lewis School for Stammerers, Detroit, Mich. It was installed primarily to carry off the fumes from over the range, as the window next to the range is but a few feet away from a window in another building where the Lewis School holds some of its classes. The arrangement, which consists of a "Sirocco" electric utility blower, made by the American Blower Company, Detroit, is, however, handling about 400 cu. ft. of air per minute and in doing this effects an air change in the kitchen



Electric Blower Fan for the Kitchen.

once every six or seven minutes, which provides good ventilation in addition to carrying away the odors.

The hood is about 6 ft. 2 in. from the floor with a rise of about 2 ft. and a flattened area on the top which is connected with the inlet pipe leading to the blower. The blower has an elbow on the outlet which is shoved up into a flue which carries off the discharge.

DIMMERS FOR REALISTIC STAGE EFFECTS.

Recognizing the growing necessity for improved apparatus for controlling the lighting of theaters, the General Electric Company has developed a form of dimmers which, while possessing reliable operating characteristics, are also capable of ready adaptation to widely varying requirements.

These dimmers consist of resistance units or plates of circular form, which may be used singly or in banks composed of several plates for controlling any number of lights and for producing any dimming or intermingled color effect desirable.

In order to obtain fine gradations of light intensity each plate is provided with a large number of contact buttons, and any objectionable flickering effects are eliminated by making the resistance divisions or steps at the first or working position of the plate finer than those at the opposite position when the reduced efficiency of the lamps renders such effects inappreciable.

For convenience of operation and for facilitating adaptation to any desired arrangement of lamps each resistance plate is provided with its own switch arm, and when several plates are

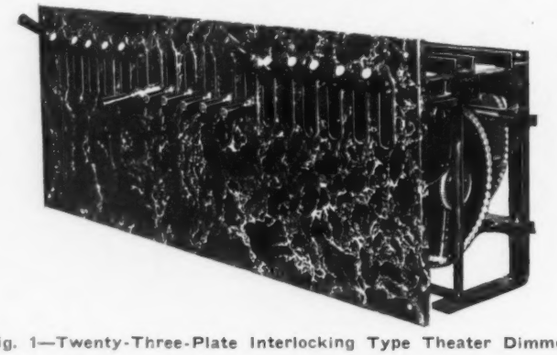


Fig. 1—Twenty-Three-Plate Interlocking Type Theater Dimmer.

combined into a bank the switch arms are moved over the contact buttons by means of levers working on a common rod or shaft. In the interlocking form of dimmers the individual levers may be readily and quickly locked to the shaft and the whole bank controlled by a master lever.

The possibility of burn-outs is reduced to a minimum by the use of liberal values in the design of the resistance plates, thus avoiding troubles the least of which would be sufficiently disastrous to the scenic effects to cause the entire failure of an otherwise successful production.

A quality absolutely essential in dimmers is noiselessness. A noisily operating dimmer offers an intolerable interference in the case of scenes requiring intense silence. This shortcoming has been entirely eliminated by carefully grinding down the contact buttons so as to bring their surfaces on an exact level with each other, thus enabling the contact piece on the switch arm to pass over the buttons without rattling. Furthermore, continued perfect contact is insured by providing means for maintaining the permanent elasticity of the switching device. This is accomplished by the addition of a phosphor-bronze spring to the steel spring attached to the switch arm for holding the contact pieces against the surfaces of the contact buttons.

The long life or service of the apparatus is greatly enhanced by the unit resistance type of construction, since it enables the removal and replacement of any plate which happens to get out of order without interfering with the continuous operation of

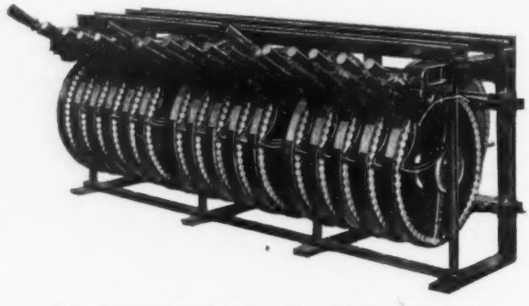


Fig. 2—Theater Dimmer with Board Removed.

the other plates. This feature is particularly important where the stage lighting is laid out on a four-color scheme with separate banks of dimmers controlling the red, white, blue and amber lights, the pocket-lights on the stage and the general illumination of the auditorium.

INDICATING BOILER FLOW METER.

The boiler meter developed by the General Electric Company is designed to indicate the amount of steam generated at any instant by a boiler or a battery of boilers. The meter apparatus complete consists of a nozzle plug, the meter proper and the necessary pipes for connecting the nozzle plug to the meter. The nozzle plug consists of a screw plug provided with a

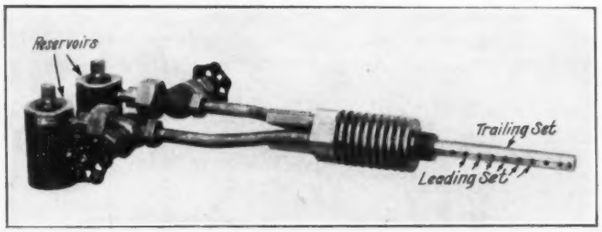


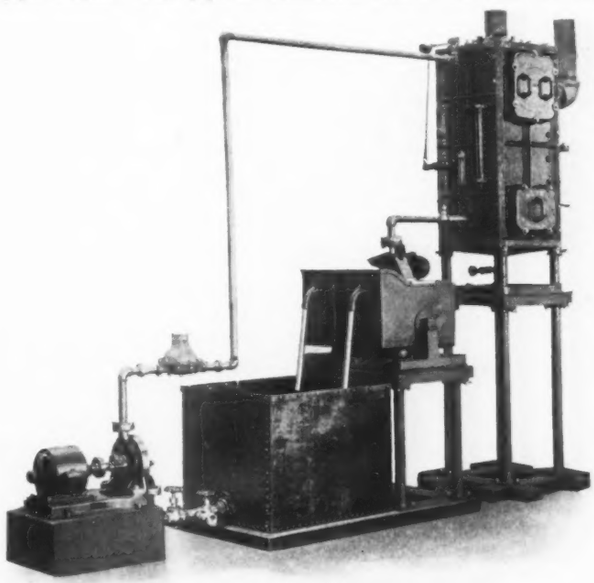
Fig. 1—Nozzle Plug and Piping for Steam-Flow Meter.

stem having two sets of orifices—a leading set arranged longitudinally and a trailing set comprising three holes located at the middle of the stem and at right angles to the leading set. The interior of the stem is divided longitudinally into two separate compartments, the leading set of orifices opening into one and the trailing set opening into the other. For operation the nozzle plug is screwed into a small hole drilled and tapped in the steam pipe, with the stem extending across the pipe and the leading set of orifices facing the direction of steam flow. When thus arranged the velocity of the steam causes a certain difference of pressure to exist in the two sets of orifices, and this difference of pressure is communicated through suitable pipes connecting the compartments in the nozzle-plug stem with the U-tube of the meter. The body of the meter consists of an iron casting cored out to form one leg and the well of the U-tube, the other leg being formed by one of the nozzle-plug connecting pipes entering the well at the opposite end. The well is filled with mercury, and the rest of the apparatus, including the connecting pipes and the compartments in the nozzle plug, is filled with water. The movable mechanism of the meter comprises a small float resting on top of the mercury in one of the legs of the U-tube and attached to a waterproof silken cord passing over a pulley and held taut by means of a counterbalance weight acting on the pulley in the opposite direction and a pair of horseshoe magnets—one inside the meter, attached to the pulley shaft, the other outside the meter, fixed to the pivoted end of the indicating needle. The axes of rotation of the two magnets are in line, and their mutual attraction exerted through a copper plug screwed into the side of the meter body casting compels them to move in unison. When the difference of pressure caused in the nozzle plug by the velocity of the steam flowing in the steam pipe is communicated to the two legs of the U-tube the mercury in the well rises or falls in the leg containing the float to a height proportional to the difference of pressure. The resulting motion of the float rotates the pulley, and the motion of the latter is transmitted through the pair of magnets to the indicating needle. The meter is easily installed, without interfering in any way with existing steam-pipe arrangements. The dial scale is 8 in. in diameter, marked with heavy flow lines and large figures on a white surface for easy reading. A target of conspicuous size is provided for designating a certain flow on the scale. The meter can be calibrated to read in pounds per hour or in boiler horse-power (30 lb. of steam per hour being taken as equivalent to one boiler horse-power), for pressures ranging from 0 lb. to 250 lb. gage; for quality ranging from 4 per cent moisture to 260 deg. Fahr. superheat, and for pipe diameters of 2 in., 3 in., 4 in., 6 in., 8 in., 10 in., 12 in. and 14 in. Meters calibrated for pipes larger than 14 in. in diameter are also built. It will be noted in this connection that for any given case a meter of this type is calibrated for a certain pressure, quality and pipe diameter, and cannot be used for any other condition.

Fig. 2—Indicating Steam-Flow Meter Connected to Pipe.

APPARATUS FOR WEIGHING LIQUIDS.

The International Steam Pump Company, New York, has recently brought out an open-pattern liquid weigher particularly developed for accurately measuring and recording by weight the flow of hot water, chemicals, oils, etc., that cannot be measured satisfactorily by meters. The weigher is independent of the density of the liquid and of its temperature, its action being governed entirely by weight and not by volume. It possesses no valves or other feature, it is claimed, which through wear or friction would afford an opportunity for any falling off in original efficiency. As may be seen from the illustration, the weigher consists of two tanks pivoted at a point in their height which is above the center of gravity when the tank is empty. As the tanks alternately fill the center of gravity is raised until it comes above and to one side of the center of support, which causes the tank to tip on its knife edge bearings and start the discharge of the liquid through the bent-pipe outlet. This pipe is continued within the tank as the



Liquid Weigher.

short leg of the siphon so that the flow being once established continues until the tank is drained. After the center of gravity has been lowered the tank tilts back to its normal position. As each tank tips it automatically turns the rocking inlet spout so as to deflect the water into the other tank and that one is filled while the first is discharging. Each movement of this spout actuates a mechanical counter which is calibrated to read either the number of load of the tanks, or directly in pounds, gallons, or whatever other unit of measure may be desired. Since the record is by weight, the counter reading is final. The weigher is shown in connection with an elevated open feed-water heater serving merely as a tank and a centrifugal pump. The group formed part of a recent exhibit in New York City.

SINGLE-PHASE AND POLYPHASE POWER-FACTOR METERS.

Every effort is made to keep the power-factor of a system high in value because to a certain extent it is a measure of the degree to which the circuits and apparatus are being utilized. In large systems the economic importance of the power-factor assumes such proportions that special means are often employed for adjusting it to unity and thus attaining maximum

Fig. 1—Power-Factor Meter.

utilization of the electrical equipment. Wherever the power-factor is adjusted it is necessary to have actual knowledge of its correct value at all times, and this is most conveniently obtained by means of a suitable power-factor meter.

One type of power-factor meter operates on the electrodynamometer principle. It depends for its action upon the time and space-phase relations of currents in a system of coils. The system consists essentially of one fixed field coil in series with the load and two movable coils mounted on the same staff and in space quadrature to each other. One movable coil is connected across a load circuit, and the other is connected across a circuit that differs considerably in time-phase from the load circuit. When there is current in all coils the movable system will take up a position such that the resultant field due to the two coils which is in time-phase with the field produced by the current in the fixed coil will be in space-phase coincidence with the fixed field.

From a consideration of the above it may be seen that for

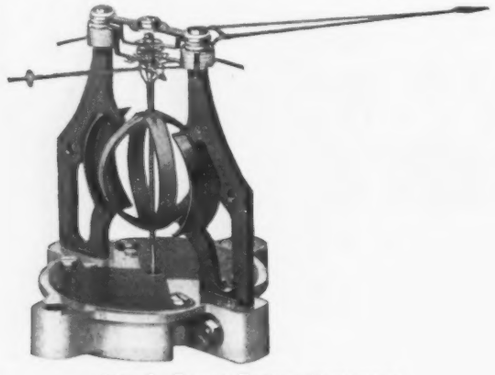


Fig. 2—Power-Factor Movement.

uniformity and permanency of calibration it is absolutely essential that all working parts be definitely and permanently located with reference to each other. In the olden types of meter the movable coils are wound separately and then one is forced inside of the other and fastened by a coating of shellac. This construction has the following disadvantages: 1. The coils are irregularly distorted from the true circular form, and, therefore, cannot be made interchangeable, as each one requires special calibration. 2. The coils are not permanently located at right angles to each other and are apt to become displaced under service conditions, thus requiring the recalibration of the instrument.

The Weston Electrical Instrument Company, of Newark, N. J., has brought out a form of electrodynamometer power-factor meter in which it has been attempted to produce an instrument having all parts interchangeable and one which will permanently hold its calibration under the usual service conditions. These results are attained by making every part accurate to dimensions and located absolutely in position with reference to every other part. The general construction of

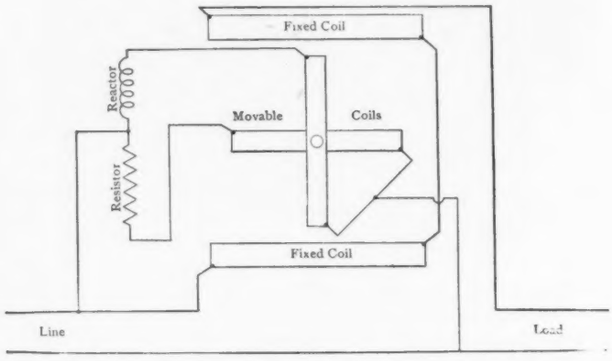


Fig. 3—Circuit Diagram of Single-Phase Power-Factor Meter.

these instruments is similar to that employed in the Weston single-phase switchboard wattmeters and possesses the same general construction and interchangeability of all parts.

In order that the movable-coil system might be made interchangeable a new type of construction had to be evolved. By this method the coils are wound simultaneously on a special machine and interlaced layer by layer at crossing points. The completed coil system is then treated with a special cement that binds the turns together and gives it the strength of a solid mass of metal, thus assuring the absolute retention of its original form.

These coil systems are pinned to the staff just as is the movable coil of the Weston switchboard wattmeter, and thus its position is definitely fixed.

All electrodynamometer power-factor meters operate theoretically without spring control, but since current-carrying filaments must be used to connect the movable coils to the external circuit some torque is always produced by the torsional moment of these filaments. In fact, it usually requires from 3 amp to

Fig. 4—Reactor.

5 amp in the series coil to produce any usable deflection of the pointer.

In the present form of power-factor meter these current-carrying filaments have been reduced almost to the vanishing point. The whole movable system weighs less than 2 grams, and, therefore, very little current is needed in order to produce the torque, and consequently the filaments have been reduced

until they have just sufficient strength to be self-supporting. It takes 16,000 of them to weigh 1 oz., and the error produced by them is only 1 per cent at one-fifth full-load current through the series coils.

These power-factor meters are equipped with the same type of air damper as is used in the Weston switchboard wattmeters and are sensitive to sudden changes and perfectly dead-beat. The meters can be used on single-phase circuits without sacrifice of accuracy. This is partly due to the method of construction and partly to the reactor used in the phase-splitting device. The reactor, which is shown in Fig. 4, resembles in general construction a core-type transformer. The core is made of extremely thin laminations and is provided with two air-gaps, one in each leg, placed in the middle of each coil. The laminations are held firmly in place by insulated bolts and the gaps are made readily adjustable. By locating the gaps in this manner instead of outside, they are shielded from stray field by the conductor turns and variations in reactance with voltage are avoided.

RECTIFIER FOR ALTERNATING CURRENTS.

The Murphy Electricity Rectifier Company, Rochester, N. Y., has brought out a 10-amp rectifier which differs materially from that shown some years ago at the New York Electrical Show. Work on larger rectifiers is also in progress, it being the purpose of the company to build a complete line to fill any requirement within the range of the commercial field. The rectifier herein described has a range of operation for any current value from a fraction of an ampere up to 10 amp, and is furnished to operate at any voltage up to 500 and for any commercial frequency from 15 cycles to 130 cycles. It is especially adapted for charging small batteries for ignition, automobile and other work, and also for supplying small direct-current motors.

The Murphy rectifier as at present designed is in effect a graphite-arc valve having an infinite resistance for current in one direction and a negligible resistance for current in the other direction. A high-tension disruptive discharge closes the

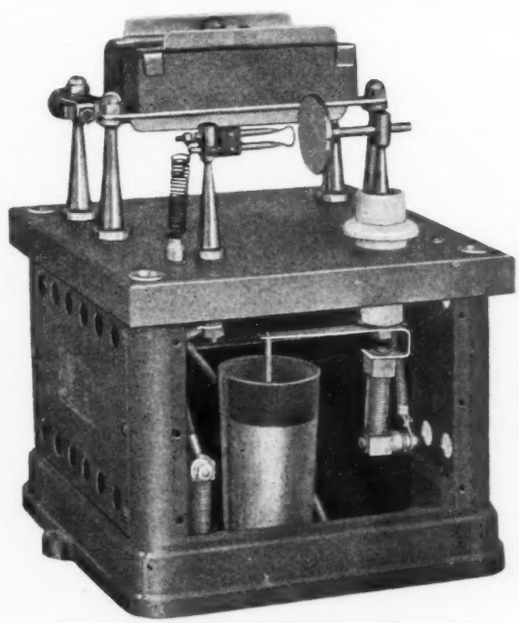


Fig. 1—Side View with Side Cover Removed.

graphite-arc valve, which is in series with the alternating-current supply and the direct-current load, and the load current (alternating supply current) follows the low-resistance path established by the high-tension discharge and forms an arc which maintains itself until extinguished by the dropping of the impressed voltage near the end of the half cycle. The disruptive discharge is furnished by an auxiliary circuit containing a small high-tension transformer, a condenser and an auxiliary spark-gap. One terminal of the auxiliary spark-gap is a nickeled disk and the other a loop of platinum-iridium wire heated to a dull-red heat by an auxiliary secondary winding on the transformer. This loop under this condition tends to

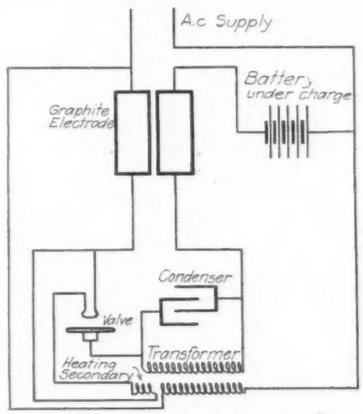


Fig. 2—Diagram of Connections.

throw off negative ions, which action lessens the resistance to current flowing in their direction and increases the resistance to current flowing in the opposite direction. The auxiliary spark-gap is adjusted so that the emf of the high-tension transformer alone will not quite establish the arc across the air-gap, but with the assistance of the stream of negative ions, the arc is established and the current flows in the same direction at every other half cycle. To aid further the valve action at the spark-gap, the transformer is excited by both alternating current and direct current, which results in a higher voltage during every other half cycle. When the current flows in the opposite direction during the other half cycle the voltage in the auxiliary circuit is not sufficient to establish the arc and no current will pass the graphite electrodes. The result is an intermittent flow of current in one direction only.

Oscillograph records show that when adjusted for normal operation no reversed current passes through the rectifier. The rectifier is self-starting and the graphite electrodes, which have a life equivalent to from 8000 kw-hours' to 10,000 kw-hours' use, are given a slight adjustment once after every 1000 kw-hours' use. The loop terminal of the auxiliary spark-gap has a life equivalent to about 2000 kw-hours' use. The accompanying curves show the efficiency of the apparatus as determined by tests at Cornell University. As the rectified current is unidirectional the power-factor of the load will be

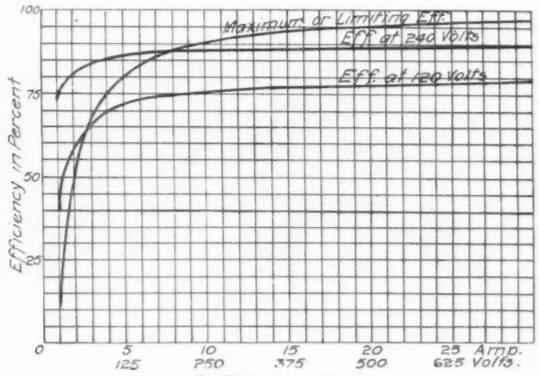


Fig. 3—Efficiency Curves.

unity for all cases in which the counter emf is always positive, as in hand-operated arc lamps, storage cells, electrolytic and resistance loads of all kinds. When reactive loads are being carried the efficiency will naturally drop with a decrease in the power-factor of the load. The rectifier occupies a space 10 in. x 10 in. x 13 in. and weighs 48 lb.

Industrial and Commercial News

The Week in Trade.

ALTHOUGH no marked changes have taken place during the week in any particular line, confidence in early improvement is reported from nearly every section of the country. Iron and steel trades have made a better showing as a result of the price reductions of the past few weeks, and prospects for new business in this field are said to be good, modified to some extent by the views of a few manufacturers that railroad purchases will be irregular during the summer months. A most favorable report on the foreign trade of the country for the month of May was issued during the week and showed new records for both exports and imports. The former aggregated $153,261,278 for the month and the latter $130,677,753, while the excess of exports over imports, $22,583,525, is nearly double this item for the corresponding month in 1910. The situation is further strengthened by the smaller number of cars reported idle in the past two weeks, the decrease, though small, being indicative of the advance in trade. Interest at this time is centered chiefly in the crop reports. There has been a lack of sufficient moisture in the Southwestern wheat area, but should the totals not reach the estimates of the earlier part of the season on this account, the harvests are expected to be satisfactory, and the prospects are regarded by many as fully equal to those of any former year, unless absence of rain is unduly extended. Conditions in the West are considered much better than in recent weeks. Railroads have done a larger business in consequence of increased shipments of live stock to the packing houses. Dry goods throughout the country are said to be maintaining their position, and demand in retail lines, though slightly under the recent scale, is mildly active.

Buyers, while withholding large commitments until more settled times, are less hesitant in purchasing for future requirements. Collections, while better in some sections of the country, continue from slow to fair. Business failures for the week, as reported by *Bradstreet's*, were 212, as compared with 232 for last week, 178 for the same week in 1910, 213 in 1909, 254 in 1908, and 165 in 1907.

The Copper Market.

AS a result of the manipulative prices which have dominated the copper market for a considerable length of time, prices were advanced during the past week, electrolytic reaching 12¾ cents per pound, the highest figure thus far for the year. Sales were in larger volume, with domestic consumers buying for July, August and September shipment up to midweek, until discouraged by the maintenance of high prices. After that time the purchasing was confined largely to foreign interests. The domestic demand came chiefly from wire-drawers, the brass interests having been more prominent in the market during the previous week. In spite of the larger sales for the week, there are no signs of general increase in consumption, nor of marked decrease in production. The larger interests are now asking 12⅝ cents to 12¾ cents for electrolytic delivered thirty days, and 13-cent copper is predicted in a short time by many in the trade. The outlook for the next few months is considered to be far brighter than it has been at any time in the present year. This is attributed to changes in selling methods, and in a measure to the gradual revival of trade throughout the country, requiring consumers to replenish stocks, although there is little doubt that the recent buying movement was only for present needs, and was induced by the advance in the electrolytic market. The prospects for continuation of foreign demand are also regarded as favorable for briskness in the trade, foreign business in finished copper having been one of the saving elements in the trade during the year. Exports for the month, including June 19, amount to 19,527 tons. The daily call on the Metal Exchange June 19 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.25	12.35	.....
June	12.25	12.35	12.30
July	12.25	12.35	12.30
August	12.25	12.35	12.30
September	12.25	12.35	12.30

The London market, June 19, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	57 0 0	57 11 3
Standard copper, futures	56 18 9	57 10 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.57½c
London, spot	£56 15 0	£53 7 6
London, futures	57 12 6	54 0 0
Best selected	60 5 0	57 5 0

Industrial and Commercial Notes.

Assignment of American Electric Fuse Company.—Dated Muskegon, Mich., June 9, 1911, Paul S. Moon, of that city, assignee of the American Electric Fuse Company, makes the following official announcement to the customers of that company: "The American Electric Fuse Company has met with certain reverses and has made an assignment to me for the benefit of all of the creditors. I have taken charge of the business and affairs of the company and am operating under the orders of the court. Customers' orders are being taken care of in the usual way. I have not yet had an opportunity to make definite plans for the permanent operation of the plant, but think there will be no change in that regard. Any orders received from you will have prompt attention the same as in the past." One estimate places the liabilities of the company at $720,000, with assets supposed to be worth from $250,000 to $500,000. After the assignment Frank G. Jones, formerly of Chicago, and for several years president of the American Electric Fuse Company, of Muskegon, was arrested on a warrant sworn out by the Old National Bank of Grand Rapids. He was charged with violating the federal banking laws, and, according to the daily newspapers, Jones admitted that in his capacity as president he had forged notes and drafts, and made false acknowledgments of accounts sufficient to develop a capital of $720,000. From Jones' confession, if the newspaper accounts are correct, he had been carrying on a losing business for a period of nearly eight years. He had no accomplices, apparently, but by a chain of forged notes and accounts he appears to have met his obligations, expecting each year to be able to repay the money he had floated in forged paper through the increased earnings of the business. This hope, however, was not realized. Many of the largest creditors are banks and note brokers. It is said that the final dénouement was almost an accident. On June 8 the Continental and Commercial National Bank of Chicago received a note for collection amounting to $3,000. The address given was the American Electric Fuse Company's Chicago branch. Owing to the recent change in street numbering in Chicago there was some difficulty in locating the Chicago branch of the company, and in consequence the alleged maker of the note was appealed to. This man declared immediately that the note was a forgery, and the Chicago bank in turn notified the bank in Muskegon from which the note had been forwarded. Jones was confronted with the evidence of his guilt and is said to have admitted with scarcely a tremor that the note was a forgery. He appeared to be glad that the matter had come to an end and not only confessed to the forgery of a $3,000 note, but outlined in brief a series of other fraudulent acts. Creditors were notified, and it was ascertained that the company was apparently a going concern with a plant worth, perhaps, $250,000, and accounts receivable worth perhaps $50,000. It is said that the factory employed about 700 men and did a business amounting to $30,000 to $35,000 a month. The bankruptcy proceedings and the arrest of President Jones followed the investigation of the creditors. Jones contended that all the money he received was turned into the business, leaving nothing whatever for himself but his home in Muskegon, Mich.

Georgia Power Company Equipment.—Contracts for the alternators, motors, transformers and controlling apparatus for the initial instalment of the Georgia Power Company's development at Tallulah Falls have been awarded to the General Electric Company. The specifications for this equipment and the ultimate requirements at the station were given in the *Electrical World*, May 4, 1911.

Organization of Federal Utilities, Incorporated.—A company known as Federal Utilities, Incorporated, to deal in public utility securities, has been organized under the laws of the State of Virginia, with an authorized issue of $3,000,000 6 per cent cumulative preferred stock and $3,000,000 common stock, $1,000,000 of the former and $2,000,000 of the latter having been issued. De Forest Candee, formerly of Lee, Higginson & Company, Boston, is president of the new company, and the other members of the executive committee are as follows: Anson W. Burchard, assistant to the president of the General Electric Company; Samuel McRoberts, vice-president National City Bank; Thomas A. Reynolds, assistant cashier National City Bank, and Harrison Williams, who is prominent in the affairs of the American Gas & Electric Company, the Federal Light & Traction Company, and is president of the Springfield Railway & Light Company, of Springfield, Mo. The company has established large offices at 60 Broadway, New York City, and will begin operations at once, and $1,000,000 has been paid into the treasury. The policy of the company involves the acquisition and sale of properties and of the securities of public utilities and other corporations having established earnings. The capital of the company will be invested in various dividend-paying securities, chiefly public utilities which have demonstrated their earning power. The investments of the company will, at all times, be diversified and sufficiently well known to be salable. The preferred stock has preference both as to principal and dividends, the company reserving the right to redeem this stock at 110 per share at any time after the date of issue. The company expects that its investments will furnish revenue sufficient to pay the 6 per cent dividend in 1911 on the outstanding $1,000,000 preferred stock, and that in addition to the income and profits which will result from the ownership of securities it will derive its largest profit from the sale of bonds, stocks, notes and other securities to bankers and other brokers. Under its charter the company may issue its own collateral trust bonds, secured by the bonds of other companies as collateral.

National Electrical Credit Association.—On June 8, at the King Edward Hotel, Toronto, the National Electrical Credit Association held its twelfth annual meeting. This is the second time in the history of the association that it has held its meeting in a large Canadian city, the former occasion being on June 23, 1905, when the delegates were entertained by the manufacturers and jobbers of Montreal. Delegates and representatives from the Boston, New York, Philadelphia, Chicago and San Francisco associations were in attendance, as well as invited guests from Montreal and Toronto. The total membership of the several associations reporting at the meeting was 478, comprising the largest and most representative manufacturers and jobbers in the electrical trade throughout the United States and Canada. This is an increase in membership of over 10 per cent in the past year. The several associations have handled 59,020 credit items, and the total number of adjustments effected has been 37,252, involving $3,073,820.15. While the association is in no sense a collection agency, yet, by its operation, it effected the adjustment of fifteen claims per member on an average, last year, and secured for each an average of $985.73. The chief value of the service, however, is the promotion of mutual confidence among its members, the securing of uniformity and certainty in the customs and usages of the electical trade and the distribution among members of credit information to save them from making unsatisfactory sales. The officers-elect for the ensuing year are: President, Mr. A. L. Miller, of John A. Roebling's Sons Company, New York; vice-president, Mr. George J. Murphy, of Pettingell-Andrews Company, Boston; general secretary-treasurer, Mr. Frederic P. Vose, Marquette Building, Chicago.

Westinghouse Railway Equipment Orders.—The following orders for electric railway equipment have recently been received by the Westinghouse Electric & Manufacturing Company: Two quadruple equipments of No. 306 split-frame interpole motors with type K-55 control, from the Parkersburg, Marietta & Interurban Railway Company, of Parkersburg, W. Va.; from the North Jersey Construction Company, Paterson, N. J., two quadruple equipments of No. 306 interpole railway motors with type HL (non-automatic) unit-switch control; from the Great Falls & Old Dominion Railroad Company, of Washington, D. C., four quadruple equipments of No. 93-A railway motors with type HL (non-automatic) unit-switch control; from the Cincinnati Traction Company, a quadruple equipment of No. 303 railway motors with type HL (non-automatic) unit-switch control; from the Boise Railway Company, of Boise, Idaho, and the Union Street Railway Company, New Bedford, Mass., each for two double equipments of No. 101-B motors, with K-36 and K-35 control, respectively; from the Lehigh Valley Traction Company, Allentown, Pa., for four quadruple equipments of No. 304 interpole railway motors, with type HL (non-automatic) unit-switch control; from the Alton, Jacksonville & Peoria Railroad Company, of Alton, Ill., five quadruple equipments of No. 304 interpole railway motors with type HL (non-automatic) unit-switch control; from the Boston Elevated Railroad Company, twenty equipments of No. 301 interpole railway motors with multiple-unit control.

Contracts Awarded for Wireless Towers.—The Baltimore Bridge Company has received the contract for the three large towers for the wireless system to be used by the Navy Department, near Washington, D. C. The plans of the Navy Department include the erection of towers at Ft. Myer, Va., on the opposite side of the Potomac from Washington, with a main tower 600 ft. in height and two others of 450 ft. About 900 tons of steel will be required for building these towers. When completed the wireless system is to be capable of sending messages between 2000 miles and 3000 miles, and by relays, to cover the North Atlantic, so that it will be possible to communicate with vessels on the coast of Europe and Africa. The instruments to be used in this system have been building and under trial at Brant Rock, Mass., for over two years, final decision to erect the system being withheld until satisfactory performance of these instruments was made. The Baltimore Bridge Company submitted alternative bids for the towers as follows: For one 600-ft. steel tower, $105,541; for two 450-ft. towers, $63,440; for two of the foregoing with complete auxiliaries, $122,954; one 600-ft. tower built on different specifications from the foregoing, $42,101; two 600-ft. towers, $82,368.

Crocker-Wheeler Sales.—Among recent sales of the Crocker-Wheeler Company are the following: A shipment of apparatus to the Franciscan Sugar Company, of Manzanillo, Cuba, including one 350-hp generator; several repeat orders for transformers from the Hartford Electric Light Company, Hartford, Conn., this making in excess of 100 Crocker-Wheeler transformers now in use by the Hartford company; a lot of twenty-two motors for the Salem Elevator Works, Salem, Mass.; complete generating equipment for the Itasca Paper Company, Grand Rapids, Minn., including one 625-kva engine-type alternator; several motor generators for the Mackay Telegraph & Cable Company; generating plant for the Alamo Cement Company, San Antonio, Tex., including one 450-kva engine-type alternator. One 4000-kw alternator is being completed for the Sanitary District of Chicago.

Aichiken Commercial Museum, Nagoya, Japan.—A handsome commercial museum, known as the Aichiken, was opened on Jan. 15, 1911, in the city of Nagoya, prefecture of Aichi, Japan. The city of Nagoya, with its 400,000 inhabitants, is yet a virgin market for foreign goods, it is said, and the purpose of the institution is to foster local trade and to build up foreign business. There are three exhibition buildings, one being devoted to machinery. The museum will gladly furnish information on business matters and act as a medium between business houses of Japan and those of other countries. It is suggested that descriptions of machinery be made very clear and in abundant detail. Mr. T. Yamaguchi is director of the museum.

Mexican Northern Power Company.—Following some interference with its work on the hydroelectric development on the Conchas River, eighteen miles from Santa Rosalia, Mexico, due to revolutionary troubles, the Mexican Northern Power Company has increased its force of workmen, to make up for lost time. The company is composed of Canadian capitalists, and it is said that the initial cost of the enterprise will be $5,000,000, gold.

Receivers for United Wireless Telegraph Company.—Receivers have been appointed for the New York, New Jersey and Maine assets of the United Wireless Telegraph Company, certain officials of which were recently convicted in the federal court of using the mails to obtain money by false pretences. The company was organized under the laws of Maine, with $10,000,000 common stock and $3,000,000 preferred.

Financial.

The Week in Wall Street.

TRADING on the New York Stock Exchange last week was irregular, and sales were slightly under those of the week preceding, amounting to 2,494,178 shares, as compared with 2,502,428 for last report. While activity is only moderate, there is an excellent tone throughout the Street, and conditions are approaching those of more stable times. The bond market, in addition to its well-maintained briskness, has been characterized by the successful sale of the Chinese government 5 per cent bonds and the oversubscription of the Panama Canal issues. Subscription for the former was closed two days before scheduled time, owing to the large subscriptions received on the day of opening, and the latter offering was, as had been expected, oversubscribed about three times. The larger bids came from bond and banking houses, and there was, no doubt, considerable duplication of funds in connection with the heavy subscription. It is likely that the government will net close to 102½ on the issue, with the sale reflecting favorably upon its credit. It is a question whether the activity of the bond market will continue throughout the summer, in view of the scale of its operations in the past few months, following the long period of depression. The stock market was influenced more acutely by the fact that Steel bookings for May were in larger volume than had been expected, and by crop conditions, than by the sale of the large issues cited above, and the dealings of the week were concerned more with the industrial issues than with the railroad shares that have been prominent in recent markets. Important price changes during the week were few in number. The absence of heavy demand for time money leaves the money market in its former state of quietness, with quotations practically unchanged. Rates June 19 were: Call, 2¼@2½ per cent; ninety days, 3@3¼ per cent. The quotations in the table are those of the close, June 19.

NEW YORK.

	June 12.	June 19.	Shares Sold.		June 12.	June 19.	Shares Sold.
All. Ch.....	8⅞*	9	325	Int. Met., pf.	52¼	51¾	4,800
All. Ch., pf..	33	31*	700	Mackay Cos..	91	90*	300
Amal. Cop...	69¼	71¼	133,200	Mackay C.,pf.	74½	74⅞	784
Am. D. T...	20½*	20½*	———	Man. Elev...	139⅞*	139*	225
Am. Loco....	42	42¾	2,100	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	109*	110*	217	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83	83*	10	Steel, com...	78	79	447,260
Am. T. & T..	151⅞	151½	15,081	Steel, pfd....	118¼	119	2,650
B. R. T.....	81¼	80⅛	14,710	W. U. T.....	81⅜	80¼	7,410
Gen. Elec...	164⅛	164¼	6,700	West'h, com..	76½	77⅛	10,877
Int. Met.....	19	18⅜	3,700	West'h, pfd..	118⅛*	118⅛*	———

PHILADELPHIA.

	June 12.	June 19.		June 12.	June 19.
Am. Rys.....	44*	44	Phila. R. T.....	19	19¾
El. Co. of A.....	11⅞*	12*	Phila. Elec.....	16⅞	17
Elec. St. Bt'y.....	55½	56	Phila. Trac.....	86¼	87½*
Elec. St. Bt'y., pfd..	30*	30*	Union Trac.....	48	49½*

CHICAGO.

	June 12.	June 19.		June 12.	June 19.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	123	123*
Chi. Rs., Ser. 1.....	80*	80*	Met. El. Co.....	25	26*
Chi. Rs., Ser. 2....	22*	22*	Met. El., pfd.....	72½*	72¼*
Com. Edison.....	128½	129	Nat'l Car.....	120*	120*
Chi. Subways.....	4⅛	4	Nat'l Car, pfd.....	119*	118½*

BOSTON.

	June 12.	June 19.		June 12.	June 19.
Am. T. & T.....	151¾	151¾*	Mex. Tel.....	4*	4*
Cum. Tel.....	157½*	159½*	Mex. Tel., pfd.....	6*	6¾*
Edison E. Ill.....	286½*	285*	N. E. Tel.....	150	150¼*
Gen. Elec.....	164¼	164¾*	W. T. & T.....	20	20*
Mass. E. Ry.....	23¼*	23⅛*	W. T. & T., pfd....	96*	96*
Mass. E. Ry., pf....	90¼	92⅝*			

*Last price quoted.
Shares sold for the week, June 12 to June 19.

Financial Notes.

Chicago Elevated Railway Merger.—Responding to the offer of Henry A. Blair, the stockholders of the South Side Elevated Railroad Company, the Metropolitan West Side Elevated Railway Company and the Northwestern Elevated Railroad Company are depositing their stock quite freely with the Illinois Trust & Savings Bank, of Chicago, and the National City Bank, of New York. As heretofore mentioned, Mr. Blair offers the following prices for the stocks, payable in cash; South Side, $75; Metropolitan preferred, $75; Metropolitan common, $27.50; Northwestern preferred, $70; Northwestern common, $30. Each depositor of stock may elect to apply 30 per cent of the cash payable to him to the purchase of preferred and common participation shares of a voluntary association formed for the purpose of acquiring the deposited stocks at the rate of one preferred share and four-fifths of a common share for each $100. The new preferred stock is to be 6 per cent cumulative. For example, a person depositing 100 shares of Metropolitan preferred is entitled to receive $7,500 in cash, or, if he wishes, $5,250 in cash, new preferred shares having a par value of $2,250 and new common shares having a par value of $1,800, making $9,300 in all at the par valuation of the new stock. One estimate of the saving to be effected by consolidation of the elevated roads places the amount at $1,000,000 a year. This will be due to economy in operation, rearrangement of routing, reduction in cost of power, saving in office expenses and other causes.

Springfield Railway & Light Company.—Lee, Higginson & Company are offering $2,000,000 first lien fifteen-year 5 per cent sinking fund gold bonds of the Springfield Railway & Light Company, of Springfield, Mo., at 96 and interest, yielding 5.40 per cent. The total authorized issues of which these bonds are a part is $7,000,000, of which $5,000,000 is reserved for additions and improvements. The bonds will be dated May 1, 1911, and will mature May 1, 1926, interest being payable May 1 and Nov. 1 in New York, Boston and Chicago. They will be callable as a whole (but not in part except for the sinking fund) at 102 per cent and accrued interest on any interest day. The Springfield Railway & Light Company was incorporated in January, 1906, under the laws of the State of Maine, owns the entire capital stocks of the Springfield Traction Company and the Springfield Gas & Electric Company and is in turn controlled by the Federal Light & Traction Company. The bonds will be secured by a first mortgage on all the capital stock, mortgage bonds and notes of the two subsidiary companies (except certain non-callable bonds), making them substantially a first lien on the entire property of the system. The proceeds of these bonds will be applied toward the retirement of all present outstanding funded debt of the Springfield Railway & Light Company and of its two subsidiary companies, either by calling the outstanding bonds or by the deposit of sufficient funds in trust. A portion of the proceeds, to the amount of $300,000, will be applied to additions and improvements to the properties. It is planned to install a new turbine unit and to make extensions to the gas and electric distribution systems which are expected to produce increases in gross and net earnings.

Edison Electric Illuminating Company of Boston.—The earning statement of the Edison Electric Illuminating Company of Boston for the month of May and eleven months ended May 31 showed a gain in gross for the month of $35,272, or 9.73 per cent, as compared with the same month in the preceding year. There was an increase of $27,889 in operating expenses, which, deducted from gross earnings, left an increase in net earnings of $7,383. In the eleven months, as above, the gross revenue was $4,859,292, which compares favorably with $4,352,759 for this item in the same period of the previous year, and is equivalent to an increase of 11.64 per cent. This gain was made with an increase of only 5.68 per cent in operating expenses. The operating ratio for May, 50.74, was the highest thus far in the fiscal year, excepting the ratio in August last of 51.94.

Ottawa Traction Merger Expected.—Plans for effecting the merger of the Ottawa Electric Railway Company, the Ottawa Light, Heat & Power Company (which controls the Ottawa Gas Company) and the Ottawa Car Company are said to be nearly completed. A holding company, with a capital of $10,000,000 5 per cent bonds and $10,000,000 stock, is a part of the plan. The present capitalization of the merging companies is as follows: Ottawa Electric Railway Company, $1,247,000 stock and $50,000 bonds; the Ottawa Light, Heat & Power Company, $2,000,000 stock, and the Ottawa Car Company, $200,000 stock.

H. M. Byllesby & Company Acquire Colorado Property.—It is understood that controlling interest in the Pueblo & Suburban Traction & Lighting Company has been purchased by H. M. Byllesby & Company, of Chicago, the consideration being $3,000,000. The deal includes the traction and electric service properties of Pueblo, power plant and distribution systems of Skaguay and Victor, together with a generating station at La Junta and other utilities controlled by the Pueblo interests.

Baltimore Consolidated Securities Placed Abroad.—President J. E. Aldred of the Consolidated Gas, Electric Light & Power Company, while recently in Europe, placed a large block of the company's 4½ per cent bonds with Messrs. Kitcat & Aiken, the London brokers.

Rumored Consolidation of Dayton (Ohio) Electrical Properties.—A conference was held at the Dayton Club, Dayton, Ohio, Friday evening by men interested in the Dayton Lighting Company, the Citizens' Electric Company and the Dayton Light & Power Company, as a result of which it is said that arrangements have been completed for the consolidation of the three companies. It was further reported that A. M. Young and Anthony Brady, both of New York, were admitted to be the controlling owners of the first two companies named, as well as the backers of the Dayton Light & Power Company, which was organized some months ago to build an electric line in the Hills and Dales, a large park near Dayton. The Citizens' Electric Company was organized in 1906 and holds a twenty-five-year franchise to operate in the city. The Dayton Lighting Company, incorporated in 1905, is a consolidation of the Dayton Electric Light Company, with plants in Dayton, Ohio, and Covington, Newport and Dayton, Ky., and the Montgomery County Electric Light Company, of Dayton, Ohio. According to a report made last year it has outstanding $1,875,000 common stock and $500,000 cumulative 5 per cent preferred stock. The authorized capital is $3,000,000 common and $500,000 preferred. The bonded debt amounts to $2,080,000, it is said. The Dayton Light & Power Company was originally the Hills and Dales Electric Company, and was incorporated with a capital stock of $25,000. The officers of the Dayton Lighting Company will be in temporary control of the consolidated companies.. They are as follows: President, E. P. Matthews; vice-president, F. M. Taft; treasurer, H. E. Talbott; secretary and general manager, F. M. Tait.

Western Union Telegraph Earnings.—The preliminary statement of earnings of the Western Union Telegraph Company for the year ended June 30, 1911, with the returns of the last quarter estimated, indicates a decrease of some $537,000 in net earnings and a decrease of over $580,000 in surplus applicable to dividends. Net earnings for the year ended June 30, 1910, were $7,274,900, while for the present fiscal year, ending June 30, 1911, the estimated earnings are $6,738,000. After payment of a 3 per cent dividend last year the surplus was $2,597,373, while the approximation for this year is $2,050,000. Following the recent directors' meeting, at which the regular quarterly dividend of three-quarters of 1 per cent was declared, this being done just before the end of the quarter, contrary to general practice, President Vail said that the business of the company has been largely increased in the last year, that there has been a gratifying increase in gross revenue, but that there has also been a large increase in expenditures, and that the results of the betterments will be reaped in the future.

United Railways & Electric Company.—An announcement is expected by July 1 of the plan by which the United Railways & Electric Company of Baltimore will raise the $2,500,000 needed to retire $2,000,000 first mortgage 5 per cent bonds and $500,000 4½ per cent certificates of indebtedness of the former Baltimore City Passenger Railway. The details are being arranged by Alexander Brown, founder of the United Railways, who still takes an active part in the affairs of the company. No details of the plan are known as yet, but it is believed that the members of the board have decided to issue three-year notes bearing interest at the rate of 5 per cent.

Sierra & San Francisco Power Company.—Arrangements have been completed by Patrick Calhoun, Ernest Thalmann and their associates for the sale of $1,000,000 of the bonds of the Sierra & San Francisco Power Company. The proceeds will be used to complete the generating station now building on the Stanislaus River and the distribution system. This company was acquired some time ago by the foregoing for the purpose of giving the United Railroads of San Francisco an independent source of power for the operations of its system in San Francisco. The surplus power will be sold in that city and neighboring localities.

New Stock to Be Issued by American Telephone & Telegraph Company.—President Vail, of the American Telephone & Telegraph Company, has stated that costs of new construction in the current year will be financed by a new stock issue, the amount and date of which has not been determined. Between one-half and three-quarters of the cost of new construction for the year, which is estimated at close to $60,000,000, will be furnished by surplus earnings, leaving between $30,000,000 and $15,000,000 to be provided for by the new issue.

South Side Street-Railway Amalgamation in Chicago.—It is said that an agreement has been reached by which the Chicago City Railway Company will take over the Chicago lines of the Chicago & Southern Traction Company, the latter an interurban company, operating from Halsted and Seventy-ninth Streets, Chicago, to Kankakee. If the plan receives the approval of the city authorities, patrons of the road between Seventy-ninth Street and the city limits will be carried downtown for a single 5-cent fare.

Orange & Rockland Electric Company.—The Public Service Commission of the Second District of New York has authorized the Orange & Rockland Electric Company to execute a mortgage on its properties, franchises, etc., to secure $500,000 twenty-year 5 per cent bonds. The proceeds from the sale of this issue will be used to refund outstanding bonds, for improvements and betterments to the power station and to pay off other obligations.

Virginia Traction Companies.—William Northrop, president of the Virginia Railway & Power Company, has been inspecting traction properties at Newport News, Hampton and Old Point Comfort, with a view to their acquisition by Gould interests.

DIVIDENDS.

American Cities Railway & Light Company, quarterly, preferred, 1½ per cent; semi-annual, common, 2½ per cent; both payable July 1.

American Gas & Electric Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1½ per cent, payable July 1.

Columbus Electric Company, semi-annual, preferred, $3 per share, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Duluth Edison Electric Company, quarterly, preferred, 1½ per cent, payable July 1.

McCrum-Howell Company, quarterly, three-fourths of 1 per cent, payable July 1.

Otis Elevator Company, quarterly, preferred, 1½ per cent; common, 1 per cent; both payable July 15.

Philadelphia Company, quarterly, 1½ per cent, payable Aug. 1.

Reading Traction Company, semi-annual, 1½ per cent, payable July 1.

Susquehanna Railway, Light & Power Company, initial, 1 per cent, payable July 1.

Tri-City Railway & Light Company, quarterly, preferred, 1½ per cent, payable July 1.

United Gas & Electric Company, quarterly, preferred, 2½ per cent, payable July 15.

United Gas Improvement Company, quarterly, 2 per cent, payable July 15.

REPORTS OF EARNINGS.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
May,	1911	$397,684	$195,863	$201,821	.....	.....
"	1910	362,412	167,974	194,438	.....	.....
11m., May,	'11	$4,859,291	$2,058,130	$2,801,161	.....	.....
" "	'10	4,352,759	1,947,431	2,405,328	.....	.....

EDISON ELECTRIC ILLUMINATING COMPANY OF BROCKTON, MASS.

April,	1911	$27,532	$16,456	$11,076	$4,358	$6,718
"	1910	22,829	12,978	9,851	3,308	6,542

HOUGHTON COUNTY (MICH.) ELECTRIC LIGHT COMPANY.

April,	1911	$20,775	$9,977	$10,176	$3,888	$6,287
"	1910	21,135	10,865	9,624	3,708	5,916

KEYSTONE (PA.) TELEPHONE COMPANY.

May,	1911	$98,839	$48,303	$50,536	$24,265	$26,271
"	1910	96,688	45,791	50,897	24,840	26,057
11m., May,	'11	$1,056,743	$525,730	$531,013	$268,937	$262,076
" "	'10	1,028.040	512,772	515,772	277,809	237,459

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

May,	1911	$377,123	$201,108	$176,015	$109,961	$66,056
"	1910	340,101	169,380	170,721	100,774	69,947

LOWELL (MASS.) ELECTRIC CORPORATION.

April,	1911	$36,637	$20,010	$16,627	$4,113	$12,513
"	1910	35,489	18,406	17,082	4,106	12,975

*MEXICAN TELEPHONE & TELEGRAPH COMPANY.

Yr., Feb.,	'11	$564,419	$258,274	$306,145	.....	.....
Yr., Feb.,	'10	480,609	229,592	251,017	.....	.....

SIERRA PACIFIC ELECTRIC COMPANY (NEVADA.)

April,	1911	$46,040	$16,012	$30,028	$5,170	$24,858
"	1910	44,797	13,991	30.805	5,052	25,753

*Mexican currency.

General News

Construction News.

FT. SMITH, ARK.—The Ft. Smith Light & Traction Company, it is reported, is contemplating extensive improvements to its system, involving an expenditure of $200,000. About $65,000 will be expended on the Garrison Avenue line and $40,000 in the Little Rock system. The remainder, it is understood, will be used to enlarge and rebuild the company's car barn for the purpose of manufacturing its own cars. J. Walter Gillette is general manager.

HELENA, ARK.—Plans and specifications have been completed by the Scofield Engineering Company, of Philadelphia, Pa., consulting engineers, for power house and equipment for the Helena Gas & Electric Company, of Helena, Ark., for which bids are now being asked.

AUBURN, CAL.—The Board of Supervisors has granted the Great Western Power Company a franchise to erect overhead transmission lines along the highways of Placer County, for which the company paid the sum of $105.

BAKERSFIELD, CAL.—The transmission line which the San Joaquin Light & Power Company is building from Bakersfield through Maricopa and McKittrick northward to join with the Coalinga line and the northern lines of the system lacks only about 40 miles of being completed. The new line will carry 60,000 volts. The Coalinga branch will be supplied with electricity generated at the steam plant in Bakersfield and the hydroelectric plants on the San Joaquin River. When the new line is completed it will be possible to use the output of the Bakersfield plant in Fresno and northward.

DUNSMUIR, CAL.—Preparations are being made by the Dunsmuir Water, Power and Light Company for extensive additions and improvements to its system, which will involve an expenditure of about $75,000.

FAIRMONT, CAL.—The proposition to issue bonds to the amount of $200,000, the proceeds to be used for municipal improvements, including the construction of a dam, tunnels and hydraulic work, in San Transquito Canyon, with power house and service lines to substations, is reported to be under consideration by the council.

FILLMORE, CAL.—Preparations are being made by the Ventura County Power Company, of Oxnard, Cal., to rebuild all of its local transmission lines to provide for the increasing demands and to improve the service.

FRESNO, CAL.—Plans have been prepared by the Fresno, Hanford & Summit Lake Interurban Railway Company for the construction of a power house at the Matteiwinery, in Fresno.

FRESNO, CAL.—It is reported that the San Joaquin Light & Power Company will reduce the price of electricity for lamps in all the larger cities and town from Merced on the north to Bakersfield and towns on the south and including Fresno to 8 cents per kw-hour after Nov. 1, 1911. The company recently established a rate of 9 cents per kw-hour in all of the towns and cities which it serves but Bakersfield, where a maximum of 12 cents per kw-hour has been maintained, pending the installation of a more modern plant. A reduction of 25 per cent is to go into effect July 1 in Bakersfield.

HEROULT, CAL.—Work has commenced on the construction of the large steel building for the Noble Electric Steel Smelter Company, in which five new smelters will be installed. The Northern California Power Company is building a large substation at Heroult for the purpose of supplying electricity to operate the plant.

LIVE OAK, CAL.—The Board of County Supervisors has granted Messrs. Metz & Berg a franchise to erect transmission lines for the distribution of electricity in Live Oak and vicinity.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is making extensive improvements and extensions to its system, which will involve an expenditure of about $550,000, of which $400,000 will be expended for additional cars. The company has recently placed orders for new motor-generator sets for substations at Pasadena, Redondo, Del Rey, Vineyards and other points, to cost about $150,000.

SACRAMENTO, CAL.—Application has been made by F. V. Keesling, of San Francisco, president of the Sacramento-Folsom Electric Railway Company, for a franchise over certain streets in Sacramento. The proposed railway is to extend from Sacramento to Folsom with a branch to Fair Oakes. The road will provide both passenger and freight service.

SAN FRANCISCO, CAL.—Arrangements have been completed for the sale of $1,000,000 in bonds of the Sierra & San Francisco Power Company to provide funds to complete its electric generating plant on the Stanislaus River, together with its distributing system. The plant, when completed, will supply electricity for the street-car lines of the United Railroads of San Francisco.

SUSANVILLE, CAL.—The Town Trustees have granted the Lassen Electric Company a franchise to erect electric transmission lines for the distribution of electricity within the corporate limits of the town. The Northern California Telephone Company has also been granted a franchise.

TULARE, CAL.—The City Trustees have granted the Tulare Power Company a franchise to erect electric transmission line for the distribution of electricity for lamps and motors within the city limits.

LA JUNTA, COL.—The Pueblo Light, Power & Traction Company has applied to the Commissioners of Otero County for a franchise to erect a transmission line down the valley from the western edge of the county of La Junta.

LA JUNTA, COL.—Application has been made to the Otero County Commissioners by John F. Vail, general manager of the Pueblo & Suburban Traction & Lighting Company, for a franchise to erect electric transmission lines across the country roads. The company is said to be contemplating the construction of a large electric generating plant in La Junta to supply electricity for industrial and manufacturing plants in La Junta and vicinity. The company already operates an electric-light station, which it proposes to replace with a larger plant.

PUEBLO, COL.—H. M. Byllesby & Company, of Chicago, Ill., it is reported, have purchased the controlling interest in the Pueblo & Suburban Traction & Lighting Company, of Pueblo. The property includes the street railway and lighting systems of Pueblo, the power plant and lighting systems in Skaguay and Victor, the electric light plant at La Junta and several other plants owned or controlled by the Pueblo company. The consideration is said to be about $3,000,000.

DANIELSON, CONN.—The Connecticut Mills Company is now operating its factory by electricity supplied by the People's Light & Power Company, from its plant on Mechanic Street. At present one 75-hp motor is used, but it is expected that another motor of the same size will be installed as soon as the new machinery is in place. Several other factories, it is said, will use electricity for motive power.

MANCHESTER, CONN.—Arrangements have been made between the North End Light & Power Company and the South Manchester Light & Power Company, whereby the management of the North End system is to be taken over by the South Manchester company on July 1.

WILMINGTON, DEL.—Work will soon begin on the construction of an addition to the No. 1 Brandywine power plant of the Wilmington & Philadelphia Traction Company, which will be erected on the north side of the Brandywine, near Buena Vista Street. The building will be 100 ft. long and 80 ft. wide, one story high. The addition, when completed, will increase the output of the plant by about 4000 kw.

TAKOMA PARK, D. C.—Plans are being considered by the Town Council for the installation of an electric-light system in Takoma Park. The Mayor has been instructed to enter into negotiations with the Potomac Electric Power Company, of Washington, D. C., to install and maintain the service. The streets are now lighted by oil lamps.

WASHINGTON, D. C.—The Secretary of the Interior has awarded the contract for furnishing copper wire for use in connection with the Boise irrigation project, Idaho, to the Standard Underground Cable Company, of Perth Amboy, N. J., for $6,197.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the chief signal officer, War Department, Washington, D. C., until July 19 for furnishing one carload of bituminized fiber conduit, Orangeburg, 3-in. socket joint, approximately 25,000 ft. per carload, including 20 gallons of coupling mixture. Captain A. S. Cowan is disbursing officer.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 26 for the construction of wireless-station buildings at the United States Reservation, Arlington, Va. Plans and specifications may be obtained upon application to the bureau. The cost of the work is estimated at about $60,000. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 27 for furnishing to the various navy yards and naval stations supplies as follows: Puget Sound, Wash.: Schedule 3655—3000 ft. single-conductor wire. Norfolk, Va.; 3568—One 7-hp electric motor, one milling machine and tool-grinding machine. Philadelphia, Pa.: Schedule 3680—One electric trolley car. Annapolis, Md.: Schedule 5—850 ft. lead-covered cable, miscellaneous enameled conduit, etc., 12 mine-type telephones. Newport, R. I.: Schedule 3688—Electric soldering irons, unmagnetic electricians' levels. Philadelphia, Pa.: Schedule 3692—1200 lb. copper tubing. Applications for proposals should designate the schedule desired by number.

FORT MEADE, FLA.—The Fort Meade Electric Light Company, recently incorporated, is reported to have awarded contracts for equipment for its plant. J. G. Fancy is president.

ATLANTA, GA.—The Cotton Belt Telephone & Telegraph Company has filed application with the State Railroad Commission for permission to issue $50,000 in bonds, the proceeds to be used for extensions and improvements to its system.

COLQUITT, GA.—It is reported that plans are being prepared by J.

B. McCrary Company, of Atlanta, Ga., for the construction of an electric-light plant in Colquitt. P. E. Wilkins is Mayor.

DALLAS, GA.—Arrangements have been completed by the Paulding County Cotton Manufacturing Company to operate its mill by electricity, which will be obtained from the power plant of the Paulding County Power Company, located 3 miles from Dallas, Ga.

DALTON, GA.—The East Tennessee Power Company has applied to the City Council for a franchise to supply electricity in Dalton. If granted a franchise the company, it is said, will have its system in operation by Sept. 1. Charles Mayfield, of Cleveland, Tenn., is interested in the company.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company is reported to be preparing plans for the development of its power site on the Grande Ronde River. It is also said that the company proposes to erect a substation east of the city and rebuild the high-tension transmission line serving the city in about a year. The Lewiston-Clarkston Improvement Company has been awarded the contract to supply the city with electricity for operating the pumping station and for street lighting.

CHICAGO, ILL.—The contract for suppying 25,000 ft. No. 6 B. & S. gage, rubber-covered, lead-incased electric-light cable has been awarded to the Simplex Electrical Company, 1144 Monadnock Block, Chicago, Ill., at $3,287.

HAMPSHIRE, ILL.—Plans are being considered for the construction of an electric railway in Hampshire. T. E. Getzelman, Hiram Gilkerson, J. F. Reid, A. A. Baker and others are interested in the project.

SYCAMORE, ILL.—The Woodstock & Sycamore Traction Company has completed its extension to Marengo, and is now making surveys for a route from Marengo to Woodstock.

ELKHART, IND.—The Indiana & Michigan Electric Company is reported to be preparing plans for the construction of a concrete dam across the St. Joseph River, just below the present dam, and the erection of large power house equipped with hydroelectric and steam equipment, capable of developing 7500 hp. J. P. Ohmer is superintendent.

FT. WAYNE, IND.—The Board of Public Works is contemplating the installation of a new coal conveyor in the municipal electric-light plant.

INDIANAPOLIS, IND.—Preparations are being made by the Indianapolis, Nashville & Southern Traction for the construction of an electric railway to connect Indianapolis, Trafalgar, Nashville, Bloomington, Bedford, Mitchell, Orleans and French Lick, bids for which will soon be asked for. Thomas F. Wakeland is secretary.

VINCENNES, IND.—The Vincennes North and South Traction Company is contemplating building an electric railway from Decker to Sullivan. B. M. Willoughby, of Vincennes, Ind., is president.

WARREN, IND.—The Town Board has made arrangements with the Marion Bluffton & Eastern Traction Company to furnish electrical energy for a day service in Warren in connection with the municipal electric system. It is proposed to supply electricity to operate manufacturing and industrial plants. The town officials would like to communicate with parties contemplating the establishment of new plants or making a change in location of their plants with a view to offering them inducements to locate in Warren. For further information address W. H. Hickerson, superintendent of municipal water and light plant.

BOONE, IA.—It is reported that the property and holdings of the Boone Electric Company, consisting of electric-light, power and street railway systems, have been purchased by Colonel W. C. Dows, Isaac B. Smith and John A. Reed, of Cedar Rapids, Ia. It is understood that extensive improvements are contemplated during this year and next.

DAVENPORT, IA.—Preparations are being made by the Iowa Telephone Company for the construction of a new telephone exchange in Davenport.

DAVENPORT, IA.—Preliminary arrangements have been completed by the Davenport-Muscatine Railway Company for the construction of its proposed railway from Blue Grass to Muscatine, contracts for which will soon be awarded. Later contracts will be awarded for building the railway from Blue Grass to Davenport. J. F. Porter is president and K. C. Weedin is chief engineer.

NEW LONDON, IA.—The contract for the construction of the power house for the municipal electric-light plant has been awarded and work on it will soon begin.

PELLA, IA.—The new municipal electric-light and water systems have been completed and will soon be put into commission. The electric plant has sufficient output to supply 8400 lamps of 16 cp. The street-lighting system includes 104 40-watt tungsten lamps. Electricity for pumping the water supply is supplied by the electric plant. The cost of both systems is estimated at about $90,000.

WEBSTER CITY, IA.—The City Council has awarded the contract for equipment for the municipal electric-light plant, bids for which were opened June 7, as follows: For engines, boilers, piping and heaters, to the Murray Iron Works, of Burlington, Ia., at $12,000, and to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for electric generators, switchboard, etc., for $9,998.

McLOUTH, KAN.—The City Council, it is reported, is considering a proposition submitted by Oskaloosa capitalists to install an electric-light system in McLouth. It is said that a franchise will soon be granted.

MELVERN, KAN.—The City Council, it is reported, is contemplating the installation of an electric-light system in Melvern. It is proposed to secure electricity for operating the system from the municipal electric plant at Lyndon, about 10 miles distant.

BOWLING GREEN, KY.—The construction of an electric railway between Bowling Green and Franklin, Ky., is under consideration.

LEXINGTON, KY.—The Kentucky Traction & Terminal Company is reported to be contemplating extensive improvements to its system which will involve an expenditure of about $800,000 and include the erection of a power plant with an output of 4750 kw, substation and the installation of new equipment.

SHREVEPORT, LA.—The Caddo Window Glass Company, of Shreveport, La., is reported to be in the market for equipment for its plant, including a boiler, engine and generator.

MONSON, MAINE.—It is reported that a large hydroelectric development is under way on what is known as Big Wilson Stream, in Elliottsville, Maine. The project will include a dam 30 ft. in height to provide power to operate a large electric generating plant. Electricity generated at the plant will be used in the slate mills, quarries and sawmills in Monson, Maine.

BALTIMORE, MD.—The Consolidated Gas and Electric Light and Power Company has awarded the contract for construction of its storage battery station to be erected on McClellan Alley, near Baltimore Street, to the J. Henry Miller Company. The building with equipment will cost approximately $300,000.

BROOKLYN, MD.—The Brooklyn Improvement Association has applied to the Public Service Commission to compel the Brooklyn and Curtis Bay Light & Water Company to extend its service to Brooklyn. The association states that the company promised the service provided 200 customers was guaranteed. The company was informed that 212 parties would take the service to begin with, but as yet the lines have not been extended to this town.

CUMBERLAND, MD.—Preliminary arrangements have been made by the Cumberland and Westernport Electric Railway Company for the construction of an extension from Westernport to Piedmont and Keyser, W. Va., a distance of about 6 miles.

ATHOL, MASS.—Preliminary surveys are being made by the Athol and Orange Street Railway Company for building an extension of its railway from Athol to Winchendon, via Baldwinville.

BOSTON, MASS.—Contracts have been awarded for material and equipment for the power plant at the City Hospital as follows: To the Lord Electric Company, of New York, N. Y., for furnishing generator, switchboard and electric wiring, at $10,750; steam fittings in power house and tunnels to Bradlee & Chatman, for $12,543; to the Ames Iron Works, of Oswego, N. Y., for engine for direct connection, at $2,600, and to John A. Rooney for fireproofing work in power house and changes in the tunnels at City Hospital, including flooring for engine rooms, at $13,370.

CLINTON, MASS.—The Clinton Gas Light Company has submitted a new schedule to the Board of Selectmen showing a reduction in the rates for both electricity and gas, to take effect Oct. 1, 1911. Under the new schedule the price of electricity will be as follows: For the first 50 kw used 18 cents per kw-hour with a discount of 2 cents per kilowatt and a discount of 6 cents per kilowatt for all used in addition to 50 kw per month. The price of gas will be reduced from $1.60 to $1.50 for the first 1000 cu. ft., and for all used above that amount the price will be $1.40.

MANSFIELD, MASS.—At a special town meeting held June 14 the citizens voted to issue bonds to the amount of $22,500, the proceeds to be used for extensions and improvements to the municipal electric-light plant.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has awarded the contract for the construction of the addition to its power house on East Street to Fred T. Ley & Company, of Springfield, Mass. The addition will be 80 ft. x 35 ft. A transformer station 40 ft. x 50 ft. will be erected on the opposite side of the street.

WESTFIELD, MASS.—The contract for additional equipment for the municipal electric-light plant has been awarded to the General Electric Company, of Schenectady, N. Y., for $3,377. The new apparatus will provide for the additional arc lamps on Elm Street and will include lamps, rectifiers. The new circuit will provide for thirty-three lamps.

DETROIT, MICH.—Arrangements are being made by the Detroit United Railway Company to begin work on the extension of the Third Avenue line out Hamilton Boulevard.

LANSING, MICH.—The Michigan United Railways Company, which has recently completed an extension to Owosso, is contemplating building another extension to Durand and to Flint.

MIDLAND, MICH.—Application has been made to the County Supervisors of Midland County by William A. Markey, of Midland, for permission to build a steel and concrete dam across Pine River in connection with a hydroelectric power plant.

NEWBERRY, MICH.—At an election held recently the citizens voted against the proposition to issue $11,500 in bonds for the construction of a new power house for the municipal electric-light plant.

BROWNS VALLEY, MINN.—The date for receiving bids for the installation of a municipal electric-light plant in Browns Valley has been

extended from June 21 to June 28. Plans and specifications are on file at the Builders' Exchange in Minneapolis and St. Paul. L. P. Bigelow is village clerk.

LINDSTROM, MINN.—The Minneapolis General Electric Company, it is reported, is contemplating extending its transmission lines to Lindstrom, Center City and Chisago City to supply electricity for lighting those towns.

MINNEAPOLIS, MINN.—The Twentieth Avenue Publicity Club has awarded the contract for lamp-posts and standards to the Flour City Iron Works and to Mr. Hartig for installation of curb lamps on Twentieth Avenue North, Minneapolis.

MINNEAPOLIS, MINN.—The Minneapolis Northern Suburban Railway Company has awarded the contract for the construction of its proposed electric railway to connect Minneapolis, Amoka, Onaway and Little. W. J. Whitcomb, of Minneapolis, Minn., is president of the company.

KANSAS CITY, MO.—The McLaughlin Engineering Company, of Kansas City, Mo., has been engaged to take charge of the engineering work in connection with the construction of the municipal electric-light plant and distributing system in Kansas City, for which $350,000 has been appropriated. Plans and specifications for the plant will be ready in about thirty days.

KING CITY, MO.—We are informed that the city of King City is anxious to have an electric-light system installed in that place, and a liberal franchise will be granted to responsible parties to establish and maintain a central station there. For further information address J. W. Sullinger, city attorney.

MEXICO, MO.—The North Missouri Central Railway Company is reported to be preparing plans for the construction of an electric railway from Jefferson City to Mexico, via Columbia, 63 miles in length. A branch will also be built from Columbia to Moberly, a distance of 39 miles. M. M. Stephens, of East St. Louis, Mo., is president of the company.

SPRINGFIELD, MO.—Bonds to the amount of $300,000 have been issued by the Springfield Railway & Light Company. The proceeds will be used for extensions and improvements to its system, including the installation of a turbine generating unit, additional gas-producing apparatus, which will double the generating capacity of the electric-lighting system, and extensions to the electric-light and gas-distributing systems.

CLYDE PARK, MONT.—The question of installing an electric-light plant in Clyde Park is under consideration. W. B. Calhoun is reported to be interested in the project.

POLSON, MONT.—Plans are being considered for the installation of an electric power plant at Hell Roaring Creek. Mayor Dawson and others are reported to be interested in the project.

DEETH, NEV.—The Board of Commissioners has granted the Deeth Mercantile Company a franchise to construct and operate an electric-light plant in Deeth.

DERRY, N. H.—Announcement has been made that the Derry Electric Light Company has been reorganized under the name of the Derry Electric Company. The officers of the new company are: Greenleaf K. Bartlett, president; Fred J. Shepard, treasurer, and Joseph B. Bartlett, manager.

FLORHAM PARK, N. J.—It is reported that the Morris & Somerset Electric Light Company, of Morristown, N. J., will accept the contract for lighting the borough and twenty-five-year franchise to supply electricity in Floral Park. The company applied for a forty-year franchise. Under the terms of the contract for street lighting the company will furnish sixty-five incandescent street lamps at the rate of $20 per lamp per year. The company agrees to have the system completed by September 1, 1911.

SANTA FE, N. M.—Charles D. Miller, Territorial engineer, has approved the application of L. A. Hughes and G. W. Prichard for water rights on the Rio Grande River at Cochiti, N. M., to be used to operate a large hydroelectric power plant. The application of Andrieus A. Jones for water rights for a proposed irrigation system in Guadalupe County, N. M., has also been granted.

BUFFALO, N. Y.—The Buffalo Southern Railway Company is considering plans for the construction of an extension to East Aurora.

BUFFALO, N. Y.—The Buffalo and Lake Erie Traction Company is reported to have decided to equip the Jamestown, Chautauqua and Lake Erie Railroad, which extends from Westfield to James, for electrical operation.

FREEPORT, N. Y.—The Village Board has awarded contracts for four mercury rectifiers, to take the place of the arc machines now in use, and for fifty lamps, to cost $2,732.

LIBERTY, N. Y.—Contracts will be awarded in the near future by the Liberty and Jeffersonville Electric Railway Company for the construction of 12 miles of new track. William Craig, of East Orange, N. J., is president.

MONROE, N. Y.—The Public Service Commission, Second District, has authorized the Orange & Rockland Electric Company, of Monroe, N. Y., to execute a mortgage, to secure an issue of $500,000 in bonds. The company has received authority to issue bonds to the amount of $134,000, of which the proceeds of $37,000 are to be used to refund outstanding bonds, $97,000 to discharge obligations of the company incurred for capital purposes, $5,000 to discharge accounts incurred for capital purposes and $44,000 for improvements and extensions to its plant and system located in Monroe. The company operates in Monroe, Chester, Blooming Grove, Woodbury Falls, Florida, Washingtonville, Central Valley, Highland Mills, Turner and Oxford Depot.

NEWBURGH, N. Y.—The Central Hudson Light, Heat & Power Company, recently formed, to take over the control of the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie; the Newburgh Light, Heat & Power Company, of Newburgh, and the Hudson Counties Gas & Electric Company, of Cornwall-on-Hudson, has asked the Public Service Commission, Second District, for permission to issue $600,000 in bonds.

NEW HARTFORD, N. Y.—The Village Board has entered into a contract with the Utica Gas & Electric Company for lighting the streets of the city for a term of five years. Under the terms of the contract the company is to furnish thirty-one arc lamps at $51 each per year on an all-night schedule.

NORTHPORT, N. Y.—Negotiations have been completed whereby the Long Island Lighting Company has purchased the property of the Northport Electric Light Company. This is a step toward the consolidation of the lighting plants at Northport, Amityville, Islip, Sayville, and Port Jefferson, permission for which was recently granted by the Public Service Commission. Plans are being made for improvements to the local plant, which will include an addition to the power house and the installation of additional machinery and involve an expenditure of about $70,000. It is proposed to supply electricity from the Northport plant to Commack, Elwood, Kings Park, Smithtown and other places. Several substations will probably be erected.

PERRYSBURG, N. Y.—Sealed proposals will be received at the office of the Department of Public Works, Room 5, Municipal Building, Buffalo, N. Y., until July 1, for furnishing and erecting power-plant equipment for a tuberculosis hospital to be known as the J. N. Adam Memorial Hospital, and located at Perrysburg, N. Y., as follows: For placing concrete foundations for boilers, engines, pumps and tanks, including excavation and placing anchor bolts, etc.; for furnishing and erecting three 80-hp boilers complete, one 80-hp engine with one 50-kw generator, one 40-hp engine with one 25-kw generator; wiring to main building, power house and laundry, switchboards, etc.; for furnishing and erecting water-supply system for fire and tank service, including duplex pump, two deep-well pumps, pressure tanks, air pumps and feed-water heater, water purifier and pump, high-pressure hot-water heater, piping for water and heating system and accessories, etc.; for furnishing and erecting laundry equipment, including all machinery, apparatus, etc.; for furnishing and erecting ice machinery, refrigerating plant, etc.; for furnishing and installing electric-light fixtures, etc., and supplying and installing fire service mains. Plans and specifications can be seen and forms of proposals obtained on application at the Bureau of Building, Room 6, Municipal Building, Buffalo, N. Y. A separate proposal must be submitted for the work and supplies furnished. Francis G. Ward is Commissioner of Public Works.

ROCHESTER, N. Y.—Plans have been approved by the Public Service Commission, Second District, whereby the eastern end of Wayne County, including the villages of Wallington, Alton, North Rose, Rose, Wolcott and Red Creek will be supplied with electricity for lamps and motors from the Niagara Falls power transmission lines. The service will be supplied by the Northern Wayne Electric Light & Power Company, which will secure energy from the Rochester Railway & Light Company for distribution.

SCHENECTADY, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 25 for the construction of United States post office building at Schenectady, N. Y., including pumping, gas piping, heating apparatus, electric conduits and wiring, and conduits, in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site, Schenectady, N. Y.

CHARLOTTE, N. C.—Paul Chatham, promoter of the local rapid transit company, has awarded the contract for grading the railway east of Charlotte. It is expected that the company will use the storage battery car on the line.

CHARLOTTE, N. C.—The Charlotte Rapid Transit Company has awarded the contract for construction of an extension of its railway from the present terminus in Elizabeth Heights, in Charlotte, to the Mecklenburg Country Club, to W. J. Oliver & Company, of Knoxville, Tenn.

RIDGEWAY, N. C.—The North Carolina-Virginia Railway Company has been granted supplemental articles of incorporation from the State Corporation Commission to build an electric railway from the North Carolina border to Ridgeway, a distance of 6 miles. The company has been authorized to increase its capital stock from $5,000 to $100,000, as the minimum, and $500,000 as the maximum amount. The headquarters of the company have been moved from Ridgeway to Roanoke, Va.

SHELBY, N. C.—Municipal ownership of the electric-light plant is under consideration. The Board of Aldermen has engaged Lamar Gidney, electrical engineer, to make an appraisal of the local plant and also to submit an estimate of erecting a new plant of sufficient capacity to supply electricity for lamps and motors in the town to be operated in connection with the water-works system.

WINSTON-SALEM, N. C.—Plans have been completed by the Mengel Box Company, of Louisville, Ky., for the erection of a new factory to be built by the company in Winston-Salem, N. C. The plant will cost complete about $100,000 and will be equipped for electric motor drive. Electricity for operating the plant will be secured from the local company.

MANDAN, N. D.—Bids will be received by Lee Nichols, city auditor, until June 29 for furnishing materials and construction of water-works system for the city of Mandan as follows: 1. General contract. To consist of hauling and laying cast-iron water mains and appurtenances, furnishing materials and constructing power house, intake, intake well, settling basins, clear-water well, etc. 2. Machinery contract. To include furnishing and erecting boilers, heater, feed pumps, engine, generator and motors, steam piping, etc. 3. For furnishing hydrants and valves. 4. For furnishing cast-iron pipe and special castings. Plans and specifications are on file at the office of the city engineer, Mandan, N. D., and at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers.

VALLEY CITY, N. D.—Bids will be received by the City Council of Valley City, N. D., until July 3 for electric lamps, wire, carbons, cylinder and other oils and such other materials as are needed in connection with the operation of an electric-light plant. Bids will also be received at the same date for sufficient coal to operate the plant for the ensuing year.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has awarded contract for electrical equipment for its proposed new plant at Cuyahoga Falls and six substations to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., at $275,000.

CINCINNATI, OHIO.—The contract for furnishing and installing two turbine water wheels in head-house filtration plant has been awarded by the Water Department to the Trump Manufacturing Company, of Springfield, Ohio, for $4,249.

COLUMBUS, OHIO.—It is reported that the Department of Public Service has adopted the plans of cluster lamps for street lighting submitted by J. William Thomas, of the firm of Howell & Thomas, architects, Broad and Fourth Streets, Columbus, Ohio. The city, it is said, will soon advertise for proposals for furnishing and erecting 900 cluster lights on the principal streets of the city, similar to the design adopted. The cost of the installation complete is estimated at $100,000, including lamp standards, to cost $40,000.

ZANESVILLE, OHIO.—The contract for electrical work at the Children's Home, near Zanesville, has been awarded to the Furges Electric Company, of Zanesville.

COMANCHE, OKLA.—Arrangements are being made for the installation of a municipal electric-light plant in Comanche, to cost about $8,000. It is understood that equipment for the plant has been purchased.

EUGENE, ORE.—The Lane County Asset Company has received authority to begin work at once on the construction of its proposed electric railway between Eugene and Elmira, a distance of 12 miles. S. P. Ness, F. A. Anderson and John Baird are interested in the project.

HOOD RIVER, ORE.—The Hydro-Electric Company, recently incorporated with a capital stock of $250,000, proposes to develop two dam sites in Hood River. One site is located on the Evans property, about 1½ miles from the city and the other a short distance above Tucker's Bridge on the county road. Mr. Evans, Dr. J. A. Watt, of Hood River, and H. J. Jackson, of Portland, Ore., are interested in the enterprise.

MYRTLE CREEK, ORE.—At an election to be held June 29 the proposition to issue $18,000 in bonds, the proceeds to be used to purchase and enlarge and improve the local electric-light and water plant, owned and operated by the Myrtle Creek Water, Light & Milling Company, will be submitted to a vote.

NEWPORT, ORE.—The contract for the survey of a hydroelectric power site and canal at the Siletz Agency has been awarded by the General Land Office, Washington, D. C., to Morris Wygant. The cost of the proposed plant is estimated at $250,000.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 26 for furnishing locomotive cranes, reinforcement steel bars, valves, pipe fittings and copper wire as per circular (No. 636-A). Blanks and general information to the above circular may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ALLENTOWN, PA.—The Lehigh Valley Transit Company is installing a new 6000-hp turbine in its power house at Allentown, which will increase the output of the plant to 23,000 kw.

ALLENTOWN, PA.—Preliminary arrangements are being made for the organization of a company to build an electric railway from Schnecksville in a northerly course through North Whitehall, Heidelberg and Lynn, to the valley of the Ontalaunce, where connection will be made with the Slatington line of the Lehigh Valley Transit Company for Reading.

ASPINWALL, PA.—Plans are being made for improvements for the municipal electric-light plant in Aspinwall. Bids for additional equipment have already been received. S. R. Chase is borough clerk.

BRADFORD, PA.—The capital stock of the Bradford Electric Light & Power Company has been increased from $85,000 to $130,000.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is contemplating the installation of generating units having a rating of 1600 kw by next November.

JOHNSTOWN, PA.—The Johnstown Traction Company has secured the right-of-way for extending its system from Walnut Grove to Giestown. Work will soon begin on construction of same.

MEADVILLE, PA.—The Northwestern Pennsylvania Railway Company will purchase one 300-kw rotary converter for its substation and one 300-kw motor-generator set for its main generating station in the near future. C. L. Murray is general manager.

NEW BRIGHTON, PA.—The Beaver County Electric Light & Power Company is reported to have purchased the municipal electric plant at College Hill. It is understood that the plant will be dismantled and electrical service will be supplied in that place from the power house at Fallston.

NEW CASTLE, PA.—Plans are being considered by the Mahoning and Shenango Railway and Light Company and the City Council for the construction of an extension of the railway out Washington Street to Cascade Park in New Castle.

PHILADELPHIA, PA.—The Fifty-second Street and Lancaster Avenue Business Men's Association has indorsed Councilman Mackey's proposal for lighting the business thoroughfares of West Philadelphia.

SCRANTON, PA.—The Scranton Electric Company has awarded the contract for the enlargement and extensions to its plant to the New England Engineering Company, of New York, N. Y. The work will cost approximately $1,000,000, and will include the installation of one 5000-kw turbine and one 2500-kw turbine at the suburban plant of the Scranton Electric Company, the installation of a complete condenser system in the main power station, rebuilding the plant and making it fireproof and laying railroad tracks for transportation of fuel from culm piles to the plant.

TITUSVILLE, PA.—The Titusville Electric Traction Company has purchased from the Erie and Central Pennsylvania Railroad Company the right-of-way, trackage, etc., between Erie and Punxsutawney.

WASHINGTON, PA.—It is reported that the West Penn Electric Company will soon apply for a franchise in Washington and other towns in this vicinity to supply electric light and power service. Electricity, it is expected, will be supplied from the company's large plant at New Haven. W. S. Kuhn, of Pittsburgh, Pa., is president of the company.

WAYNESBURG, PA.—The Waynesburg and Blacksville Street Railway Company is asking for bids for the construction of its proposed electric railway from Waynesburg to Blacksville, a distance of 15 miles.

WEST CHESTER, PA.—Surveys have been completed and most of the right-of-way secured by the West Chester Street Railway Company for its proposed electric railway from Pequea to Mt. Nebo, which will connect with present line at Rawlinsville. It is understood that work will soon begin on construction of the road.

PROVIDENCE, R. I.—Work has commenced on the laying of the cable for the Narragansett Electric Lighting Company, which is to connect Nayatt Point with Conimicutt Point, a distance of about 2 miles.

BLACKSBURG, S. C.—The Council is reported to be considering the question of installing a municipal electric-light plant in Blacksburg.

EDGEFIELD, S. C.—Plans have been prepared by J. B. McCrary & Company, of Atlanta, Ga., for the municipal electric-light plant, for which bonds to the amount of $15,000 were recently issued.

MURDO, S. D.—The Interior Telephone Company is reported to be considering several propositions to erect several extensions out of Murdo.

DYER, TENN.—Bids will be received by the Mayor and Board of Aldermen of Dyer, Tenn., until June 27, for materials and construction of water-works system as follows: One 60-hp gasoline engine, directly connected to underwriters' fire pump; deep-well pumping outfit, operated by an electric motor; 150,000-gal. reservoir, 40,000-gal. steel tank on 50-ft. tower, brick or concrete pumping station, 2600 ft. 8-in., 5200 6-in. and 15,100 ft. 4-in. pipe; 41 hydrants, 21 valves and boxes. R. C. Houston is consulting engineer. R. B. Daniel is Mayor.

GREENVILLE, TENN.—At an election held recently the proposition to issue bonds to the amount of $65,000, the proceeds to be used for the purpose of acquiring or constructing an electric-light plant and water-works, was carried.

MEMPHIS, TENN.—Preparations are being made by the Tennessee Traction Company for the construction of an electric railway from Memphis to Brownsville. Later the road will be extended to Jackson, Tenn.

ALVIN, TEX.—The Alvin Water, Light & Ice Company, recently organized with a capital stock of $20,000, will take over the property of the Alvin Ice, Light & Refrigerating Company. It is understood that the new company will install a new electric-light and water plant.

AMARILLO, TEX.—The City Council has authorized the installation of 100 additional electric street lamps to be erected as soon as possible. The Amarillo Water, Light & Power Company supplies electrical service in Amarillo.

AUSTIN, TEX.—Two bids were submitted to the City Council for the reconstruction of the dam across the Colorado River at Austin. The J. F. Cogan Company and the Hydraulic Properties Company, both of New York, N. Y., were the bidders. The proposition offered by the J. F. Cogan Company agrees to rebuild the dam and install a hydroelectric plant in Austin for $1,250,000 and provides for terms of payment as follows: For $100,000 when the dam has reached low-water mark; another $100,000 when the dam is completed and machinery installed; $300,000 in semi-annual payments of $30,000 each for a period

of the next five years, and $750,000 in semi-annual payments of $25,000 each for the next ensuing fifteen years. The proposal submitted by the Hydraulic Properties Company provides for the construction of a patent dam and installation of a hydroelectric plant at a cost of $1,400,000, of which $100,000 is to be paid upon completion and acceptance of the dam and the remainder in twenty-six semi-annual instalments of $50,000 each.

BONHAM, TEX.—Plans are being considered by the Bonham Electric & Gas Company for the construction of a new electric plant within the city limits to take the place of the present plant in Russell Heights, work on which will soon begin. It is understood that the company has placed a contract with Deering & Son to bore a deep well for the electric plant.

BROWNSVILLE, TEX.—The City Council has authorized a reduction in the rates in electricity for lamps supplied by the municipal electric plant to take effect from July 1. Under the new schedule the prices will be reduced from 25 to 50 per cent.

BROWNSVILLE, TEX.—It is reported that the City Council has ordered the Brownsville & Gulf Railway Company to remove its track which extends for a mile through the heart of the town. The company recently applied for a franchise to operate a motor service over the track, which was refused. The City Council is inviting applications for a franchise for an electric-railway system to cover the principal streets of the city.

EBENEZER, TEX.—Plans are being considered by the Alamo Land & Sugar Company for the construction of an interurban railway system, 16 miles in length, to run from Ebenezer to various points upon its tract of 32,000 acres, located near here, work on construction of which will soon begin. Gasoline cars will be used at first, but later on electricity will be substituted for motive power. The Alamo Land & Sugar Company owns one-half interest in the Louisiana-Rio Grande Sugar Company, which has just finished the construction of an extensive irrigation system for a 32,000-acre tract. C. D. Hellen, of Des Moines, Ia., is interested in the project. Ebenezer has not a post office.

LORAINE, TEX.—The installation of an electric-light plant in Loraine is reported to be under consideration. For further information address W. T. Mullin, of Loraine.

McKINNEY, TEX.—The Commercial Club of McKinney is reported to be promoting the construction of an electric railway between this city and Bonham, a distance of 36 miles.

SAN ANGELO, TEX.—The power plant of the San Angelo Street Railway Company was destroyed by fire on June 8, causing a loss of about $25,000. The property was recently purchased by J. D. Sugg at a foreclosure sale.

WAXAHACHIE, TEX.—The City Council has granted the Stone & Webster Management Association, of Boston, Mass., a fifty-year franchise to construct and operate an electric railway and build a power plant in Waxahachie.

LAWRENCEVILLE, VA.—The proposition to issue bonds to the amount of $50,000, the proceeds to be used for the installation of water-works, sewerage and electric lighting, is reported to be under consideration.

CENTRALIA, WASH.—Arrangements are being made by the Washington-Oregon Corporation for the installation of a hydroelectric power plant on the Kalama River, to cost about $750,000. A pipe connection covering a distance of 60 miles will be laid to carry the power to the cities of Centralia and Chehalis. The company owns and operates the local electric-light and power plant, street-car system and waterworks. Isaac Anderson, of Tacoma, Wash., is president, and A. Welch general manager of the company.

CONCONULLY, WASH.—J. C. Morton is reported to have been granted a franchise to construct and operate an electric-light plant and water-works system in Conconully, work on which will begin at once. The electric plant will at first be operated by steam power, but later water power will be used.

COULEE CITY, WASH.—The City Council is reported to have granted the Pacific Power & Light Company a franchise to erect electric transmission lines in Coulee City.

DAYTON, WASH.—The County Commissioners have granted the Pacific Light & Power Company a franchise to extend its transmission line along the old Lewiston road from the Walla Walla County line, passing through Dayton to Garfield County.

KLAMATH FALLS, WASH.—Preparations are being made by the Klamath Falls Light & Water Company for increasing the output of its plant to meet the increasing demands for electrical service. Orders have been placed for a 1000-hp Pelton-Francis turbine, which will replace the 500-hp turbine now in use.

LACROSSE, WASH.—It is reported that Harry C. Wilson, lessee of the local water-works system, is contemplating the installation of an electric-light plant with sufficient output to supply 150 lamps of 16 cp.

SEATTLE, WASH.—The Commissioners have granted George W. H. White a franchise to construct and operate a railway over the Seattle-Tacoma boulevard for a term of fifty years, with permission to use trolley, electric-storage or gasoline motor-driven cars.

VANCOUVER, WASH.—The local power plant of the Portland Railway, Light & Power Company was destroyed by fire on June 4, causing a loss of about $65,000. Electricity is now being supplied in Vancouver from the Portland plant through an emergency cable. Through error this item appeared under Vancouver, B. C., Can., in the issue of June 15.

BEAVER DAM, WIS.—The installation of an ornamental street-lighting system in Beaver Dam is under consideration.

MINOCQUA, WIS.—The Town Board has extended the date for receiving bids for the installation of an electric-light plant from June 23 until July 6. W. H. Fisher is town chairman.

BASIN, WYO.—The Katz-Craig Contracting Company, of Omaha, Neb., was awarded the contract for the entire work for improvements in connection with the water-works and electric-light plant at Basin, Wyo., for $58,582. The contract includes cast-iron pipe, at $11,948; hydrants, pumping and electrical machinery, at $12,250.

STETTLER, ALTA., CAN.—Sealed tenders will be received until July 3 for the following equipment: One 125-kva generator, exciter and switchboard, one tandem, compound steam engine, one 72-in. x 16 ft. boiler and stack, cedar poles and line material and erection of pole line. Specifications and further information may be obtained at the office of the John Galt Engineering Company, 317 Portage Avenue, Winnipeg, Man. David Mitchell is town commissioner.

VANCOUVER, B. C., CAN.—Preparations are being made by the British Columbia Corporation Company, of Vancouver, B. C., for the construction of a new sawmill on Lulu Island, New Westminster, B. C., with a daily capacity of 200,000 ft. A shingle mill, planing mill and box factory will also be built. The entire plant will be equipped for electrical operation. Arthur Pracna, of Seattle, Wash., will have charge of the engineering work.

VICTORIA, B. C., CAN.—Proposals will be received by the Canadian Collieries (Dunsmuir) Ltd., until June 26 for construction necessary in the development of hydroelectric power on the Puntledge River, Comax, B. C., the work to include clearing, construction of dams, flume, pipe line and power house, plans and specifications for which may be obtained at the office of the company, Pemberton Block, Victoria, B. C. W. L. Coulson is general manager. H. K. Ownes, Central Building, Seattle, Wash., is consulting engineer.

BRANTFORD, ONT., CAN.—The Brantford and Port Dover Railway Company will receive bids until August 1 for the construction and equipment for its proposed 30-mile electric railway. The 6600-volt, single-phase line will be carried on steel towers and five large bridges will be built.

HAMILTON, ONT., CAN.—The Dominion Power & Transmission Company has engaged F. E. Frothingham, engineer, of Boston, Mass., to make investigations and submit a report in connection with the proposed extensive additions which the company proposes to make to meet the demands of the rapid expansion in the population and area of the city.

NIAGARA FALLS, ONT., CAN.—Tenders will be received by J. Robinson & Sons, Niagara Falls, Ont., Can., until Aug. 1 for electrical equipment as follows: Electric rectifier, lathe, drill press and shaper.

SOUTH LORRAINE, ONT., CAN.—The South Lorraine substation of the Mines Power Company is reported to have been destroyed by fire recently, causing a loss of about $10,000. Arrangements have been made to restore the service at once.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has announced a reduction in its rates for electricity for lamps to take effect from July 1. Under the new schedule the price will be reduced from 9 cents per kw-hour for commercial service and 8 cents per kw-hour for residential lighting to 7½ cents per kw-hour on five-year contracts.

PRINCE ALBERT, SASK., CAN.—Sealed tenders will be received by the Corporation of the city of Prince Albert, Sask., until June 26 for the construction of power station superstructure and transmission line, being portions of the proposed hydroelectric power development on the North Saskatchewan River at La Colle Falls, 25 miles distant from the city. Plans and specifications are on file at the City Hall, Prince Albert, Sask., and at the office of C. H. & P. H. Mitchell, Traders' Bank Building, Toronto, Ont., Can. C. O. Davidson is secretary and treasurer.

New Industrial Companies.

THE ELECTRIC MACHINERY & WIRING COMPANY, of Kansas City, Mo. has been chartered with a capital stock of $9,000 by T. B. Stuszer, John H. Shaw and Theodore Remley, all of Kansas City, Mo.

THE E-Z TELEPHONE RECEIVER COMPANY, of Camden, N. J., has been chartered by J. B. Fellheimer, D. C. Reed and S. R. Leap, Jr., all of Camden, N. J. The company is capitalized at $125,000 and proposes to manufacture telephone receivers.

THE INDUCTION SIGNAL & SAFETY STOP COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 to manufacture signaling devices, etc. The incorporators are: M. L. Sindeband, C. B. Woticky, both of New York, N. Y., and W. Bishop, of Yonkers.

THE JUSTRITE VACUUM CLEANER COMPANY, of Bloomington, Ill., has been incorporated by Lewis C. Walter, Burdette C. Gilmore and A. W. Rigby. The company is capitalized at $25,000 and proposes to manufacture vacuum cleaners.

THE KANSAS CITY ENGINE WORKS, of Kansas City, Mo., has

filed articles of incorporation with a capital stock of $100.000 by A. W. Calkins, J. E. Elliott and A. D. Elliott. The company is planning to establish a plant to manufacture engines and also for repair work.

THE METAL POLE POST COMPANY, of Kansas City, Mo., has been incorporated by C. A. Thompson, E. S. Winston and S. J. Mead. The company is capitalized at $50,000 and proposes to manufacture a patent device to be used as a substitute for wooden poles, posts, etc.

THE MULTIPLE SIGN COMPANY, of Louisville, Ky., has been incorporated by A. C. Bowen, John C. Hughes, George T. Wood, William C. Kentrick and J. J. Roberts. The company is capitalized at $10,000 and proposes to manufacture changeable electric signs.

THE PORSTH ELECTRIC COMPANY, of New York, N. Y., has been incorporated by Robert E. Denike, 214 Park Avenue, Brooklyn, N. Y.; Emmile Pincus, 7 Beekman Street, and Arthur L. Semel, 220 Audubon Avenue, both of New York, N. Y. The company is capitalized at $25,000 and proposes to do general contracting and electrical work of all kinds.

THE RHODE ISLAND GLASS COMPANY, of Central Falls, R. I., has filed articles of incorporation under the laws of the State of Rhode Island. It is understood that the company will locate in Central Falls. The company is capitalized at $100,000 and proposes to manufacture glass to be used in making globes for electric lamps. The incorporators are: Francis B. Keeley, Herbert K. Humphrey and Thomas F. Sexton.

THE SUPERIOR MANUFACTURING & MILL COMPANY, of Springfield, Ohio., has been chartered with a capital stock of $50,000 for the purpose of manufacturing gas and gasoline engines, pumps and feed mills. The company proposes to establish a plant on East Street in Springfield. George C. Lynch, temporary president of the company, has purchased the property of the O. S. Kelly Manufacturing Company, of Iowa City, Ia., and will remove the machinery to the Springfield plant.

THE WATERSON POWER SAVING COMPANY, of Bristol, Tenn., has been chartered with a capital stock of $150,000 and proposes to manufacture a mechanical device. The officers are: J. A. Dickey, president; B. K. Vance, secretary, and G. M. Turner, treasurer.

New Incorporations.

CENTERVILLE, ALA.—The Centerville Light & Power Company has been chartered with a capital stock of $15,000 by John P. Kennedy, H. E. Reynolds, J. N. Lightsey and O. C. Oakley.

GADSDEN, ALA.—Articles of incorporation have been filed for the Alabama Power & Light Company by R. A. Mitchell, E. T. Hollinsworth, T. S. Kyle, O. R. Goldman and G. C. Allen. The company proposes to develop water-power on Little River, near the town of Blanche, about 30 miles north of Gadsden, and on other streams in this section of the State. The company's charter gives it the right to do business in Cherokee, DeKalb, Marshall, St. Clair, Morgan, Madison, Etowah, Calhoun and Talladega counties. The company is capitalized at $1,000.

MOSS BEACH, CAL.—The Half Moon Bay Light & Power Company has been chartered with a capital stock of $25,000 by J. J. Gomes, M. Codivo, Benjamin Cunha, Joseph Fernandez and F. N. Staley.

STOCKTON, CAL.—Articles of incorporation have been filed for the Joaquin Delta Railway Company with a capital stock of $500,000 by E. W. and L. H. Woods, Frank West and E. L. Wilhoit, of Stockton; W. P. Plumer, I. L. Borden and M. E. Cerp, of San Francisco, Cal.

DRY BRANCH, GA.—The Dry Branch Telephone Company has been incorporated with a capital stock of $10,000. T. S. Tharpe is interested in the company.

COUNCIL, IDAHO.—The Boise-Council-Ladrone Railroad Company has been incorporated by E. W. Rowman, C. M. Hail, D. S. Manville, Henry C. Wyman and George H. Bener. The company is capitalized at $2,000,000 and proposes to build an electric railway from Council through the fruit belt of Adams County and the mining and timber regions of the Seven Devils sections.

CHICAGO, ILL.—The Cicero & Southwestern Railways Company has been incorporated with a capital stock of $1,000 to build electric railways in Illinois. The incorporators are Emil R. Rosenthal, Louis Cohern and Augustus J. C. Timm.

CHICAGO, ILL.—The Central Terminal Railway Company has filed articles of incorporation with a capital stock of $2,000,000 for the purpose of building a railway from Forest Park to Chicago. The incorporators are Donald R. McLennan, Charles E. Vroman, Joseph W. Hiner, Fayette S. Munroe and John C. Vroman, all of Chicago, Ill.

PIKEVILLE, KY.—The Sandy Valley Telephone Company has been incorporated with a capital stock of $10,000 by W. E. Johnston, R. M. Deskins and John W. Kerr.

HERMISTON, ORE.—The Hermiston Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by W. H. Skinner, president; Henry Sommers, P. P. Sullivan and Charles E. Percy.

CRESSONA, PA.—The Eastern Pennsylvania Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are C. E. Calder, of Pottsville, Pa., treasurer; W. B. Rockwell, Van Dusen Rickert, all of Pottsville, Pa.

POTTSTOWN, PA.—The Pottstown & Phoenixville Railway Company has been chartered with a capital stock of $6,000. The directors are George N. Malsberger, of Pottstown, Pa., president; C. Taylor Leland, Harry C. Case, of Newton, Pa.; Charles W. Rambo, of Spring City, Pa., and Harry F. Swinehart, of Pottstown, Pa.

RICHLAND, PA.—The Richland Township Light, Heat & Power Company has filed articles of incorporation with a capital stock of $5,000. The directors are Eugene A. Delany, of Windber, Pa., treasurer; John R. Caldwell and W. R. Calverly, both of Windber, Pa.

WINDBER, PA.—Articles of incorporation have been filed for the Adams Township Light, Heat & Power Company with a capital stock of $5,000. The directors are Eugene A. Delaney, of Windber, treasurer; John R. Caldwell and W. R. Calverly, both of Windber, Pa.

SEATTLE, WASH.—Articles of incorporation have been filed for the United Power, Irrigation & Development Company with a capital stock of $500,000 by J. P. Smith, J. E. Wright, A. J. Nichols, G. E. Lingerfelt and E. J. Flateboe

VANCOUVER, WASH.—The Washington Engineering & Securities Company has been incorporated with a capital stock of $3,500,000 to operate light and power plants. The incorporators are E. M. Scanlon, James P. Stapleton, of Vancouver, Wash.; E. P. Summerson,, L. W. Osborne, D. J. Anderson and O. R. McMahon, of New York, N. Y.

FAIRMONT, W. VA.—The East Side Telephone Company has been granted a charter with a capital stock of $10,000. The incorporators are A. A. Hamilton, D. S. Huffman, George A. Nuzum, Paul Hamilton and others.

OTTAWA, ONT., CAN.—The Imperial Traction Company has been chartered to construct and operate an electric railway from Hamilton to Stratford and London, with extensions to Sarnia and Niagara Falls.

Personal.

MR. H. J. FREYN, formerly with the Illinois Steel Company, South Works, South Chicago, Ill., has accepted a position with the Allis-Chalmers Company of Milwaukee, Wis.

MR. RALPH MODJESKI, of Chicago, received the degree of doctor of engineering from the University of Illinois during the commencement exercises at Urbana, June 14.

MR. F. E. FROTHINGHAM, consulting engineer, Boston, has been engaged by the Dominion Power & Transmission Company to report upon extensions to be made to its system in Hamilton, Ont.

MR. JAMES R. CRAVATH, of Chicago, has been appointed a director of the Illuminating Engineering Society, succeeding Mr. E. W. Lloyd, of the Commonwealth Edison Company, Chicago, resigned.

PROF. ALBERT A. MICHELSON, head of the department of physics of the University of Chicago, has received the honorary degree of doctor of philosophy from the University of Göttingen, Germany. Dr. Michelson is exchange professor at Göttingen this year.

MR. J. E. POWELL, chief mechanical and electrical engineer, office of the Supervising Architect, Treasury Department, Washington, has resigned on account of ill health. Mr. Nelson S. Thompson, who was assistant chief engineer, has succeeded to the position.

MR. WYNN MEREDITH, San Francisco, has been appointed consulting engineer in charge of the work to be undertaken by the city of Victoria, B. C., in developing the Sooke Lake scheme of water supply. Mr. Meredith has been a full member of the American Institute of Electrical Engineers since 1903.

MR. E. C. NEWMAN has resigned his position as manager of the appliance department of the Concord Electric Company, of Concord, N. H., to accept a position as head of the new-business department of the Kennebec Light & Power Company, Augusta, Maine. Mr. W. F. Stevens has been appointed to fill the position left vacant by Mr. Newman.

MR. ALTEN S. MILLER, at present president of the Union Electric Light & Power Company, St. Louis, was the guest of honor and principal speaker at a recent meeting of the League of Electrical Interests of that city. Mr. Miller claimed that the rapid development of the South and West renders St. Louis a natural center for consulting engineers and said that the work to be done is sufficient to keep busy many more engineers than are now located at that place.

MR. G. F. STRADTMILLER, manager of the Erie (Pa.) office of the Western Union Telegraph Company, has been promoted to be district commercial manager, with headquarters in Jamestown, N. Y. Jamestown is now the headquarters of a sub-district, including a number of counties in the southwestern part of New York State and the northwestern part of Pennsylvania. Mr. J. C. McGrew, who has been manager of the Jamestown office of the Western Union Company, has been promoted to be local manager for the company in Erie.

MR. ALFRED STILL, of Eccles, Lancashire, England, who recently accepted a position with the Lake Superior Power Company, Sault Ste. Marie, Ont., is the author of two books entitled "Polyphase Currents" and "Alternating Currents of Electricity and the Theory of Transformers." He has contributed frequently to the technical press, among his articles being the following that have appeared in these columns: "Armature Losses in Double-Current Generators," Aug. 12, 1905; "The Single-Phase Induction Motor," Dec. 8, 15 and 22, 1906; "Inductance of Electric Transmission Lines with Unsymmetrically Disposed Conductors," May 23, 1908; "Transmission Line Calculations," Sept. 15, 1910.

and "Unusual Current Relations in Condensive and Inductive Circuits," Jan. 26, 1911. The present issue contains an article by him entitled "Inductance of Three-Phase Transmission Lines When the Conductors Lie in the Same Plane." Mr. Still is a member of the (British) Institution of Electrical Engineers and an associate member of the (British) Institution of Civil Engineers.

MR. S. W. GREENLAND has been appointed assistant general manager in charge of the lighting and motor service department of the Fort Wayne & Northern Indiana Traction Company to succeed Mr. M. J Kehoe, who has resigned to become connected with the Fort Wayne Oil & Supply Company. Mr. Greenland, who was secretary-treasurer and general manager of the Columbus (Miss.) Railway, Light & Power Company prior to becoming purchasing agent for the Fort Wayne company, has recently had charge of operation since the resignation of general manager C. D. Emmons, to become general manager of the Chicago, South Bend & Northern Indiana Railway and the Southern Michigan Railway, South Bend, Ind.

Trade Publications.

THE SUNRAY ELECTRIC LAMP MANUFACTURING COMPANY has moved its offices from 109 West Forty-second Street to 311 West Fifty-ninth Street, New York.

RAILROAD TELEPHONE AND SELECTIVE APPARATUS.—Bulletin No. 1080 issued by the Western Electric Company is replete with information of value to contemplating purchasers of railroad telephone and selective apparatus. It lists only standard apparatus for this class of work, showing the apparatus, describing it, pointing out its use and giving prices.

TRANSFORMER FOR BELL-RINGING CIRCUITS.—Bulletin No. 1152 of the Pittsburgh Transformer Company, Pittsburgh, Pa., is devoted to small bell-ringing transformers built in two sizes and suitable for connection to 60-cycle or 25-cycle, 100-volt to 125-volt circuits. Three low voltages are available, the smaller size giving 4, 8 and 12 volts and the larger size 6, 10 and 16 volts.

SMALL LOW-VOLTAGE TRANSFORMERS.—"Pittsburgh Mazda Transformers" is the title of Bulletin No. 1151 issued by the Pittsburgh Transformer Company and covering a new line of small low-voltage transformers. The wide use of electric signs using low-voltage lamps and interior low-voltage lighting has become so important that the Pittsburgh Transformer Company has developed a special line of transformers with very low core and copper loses.

ELEVATING AND CONVEYING MACHINERY.—General catalogue No. 40 issued by the Chain Belt Company, Milwaukee, Wis., contains complete information on the company's line of elevating, conveying and concrete machinery. Every part of the system is illustrated as well as the system as a whole, and the work is replete with tables of sizes, weights, etc., of the materials used in their make-up. The catalogue is bound in cloth and contains 278 pages.

ELECTRIC FITTINGS.—The H. T. Paiste Company, Philadelphia, Pa., has issued Paistery No. 81, pipe-taplet bulletin. Pipe taplets bear the same relation to conduit wiring that fielding and molding taplets bear to wooden molding wiring, and not only are the pipe taplets standardized but the wiring material as well. The pipe taplets are a series of nine types of iron fittings with uniform openings, on the ½-in., ¾-in. and 1-in. sizes of which can be used all standard sockets, receptacles, snap switches, etc.

ELECTROMEDICAL APPARATUS.—A pamphlet describing electromedical apparatus has been published by Dr. Richard Heilbrun, Berlin, Germany. The first two sections treat of transforming apparatus and auxiliary instruments, and the other sections of material of importance to doctors and hospitals, such as massage motors and fittings, electrically driven surgical instruments, lamps for operating and consulting rooms, heating pads, hot-air fans, electric sterilizers, portable stoves, fans, ozone generators, light baths, etc.

ORNAMENTAL LAMP STANDARDS.—One of the most potent factors in the rapid introduction of ornamental street lighting in downtown business sections, next to the use of the tungsten lamp itself, is the design of the post. The latter offers such a marked contrast to the old wooden poles and arc lamps that it is its own best advertisement. The Flour City Ornamental Iron Works, Minneapolis, Minn., manufactures a line of ornamental standards of pleasing proportions which are illustrated and described in a brochure just off the press.

INTERNAL-COMBUSTION ENGINES.—The Foos Gas Engine Company, Springfield, Ohio, has issued Catalogue No. 23 and Circular No. 82, the first describing the single-cylinder horizontal type of gas engine built in sizes ranging from 3 hp to 90 hp, and the second devoted to the vertical multiple-cylinder gas engine. The engines are designed to operate on all liquid fuels, including kerosene, naphtha, distillate and alcohol, and on natural, artificial and producer gas. A number of stationary and portable gas-engine-driven electric generator sets are shown in the catalogue.

POLYPHASE INDUCTION MOTORS.—Induction motors of large size are described in a pamphlet recently issued by Bruce, Peebles & Company, Ltd., Edinburgh, Scotland. Two separate types of machines are dealt with in the pamphlet, open-bedplate type machines arranged with two or three bearings, and end-hood pedestal type machines, which, having pedestal bearings carried on the end hoods, are suited for direct coupling to pumps, fans, etc. The machines are listed for circuits of from 110 to 6600 volts, and the approximate weights and dimensions of both types are given.

ELECTROMAGNETIC PRESSING EQUIPMENT.—Booklet No. 201 issued by the Electro-Magnetic Appliance Company, Cleveland, Ohio, describes the cloth-pressing machine built by the company. The machine is operated from an ordinary incandescent lamp socket, the iron itself, however, being equipped for other than electric heat. A counterbalanced foot lever connects the magnet control so that the arm to which the iron is attached automatically produces a momentary, slight uniform pressure before greater pressure can be applied. Pressures as high as 4000 lb. may be secured.

TALKING SIGNS.—The Wall-Win Company, Jersey City, N. J., has issued Bulletin No. 208, describing the talking sign, or, as it is sometimes called, the Mason monogram. As is well known the sign is made up on a unit system so designed that a sign with any number of monograms can be erected. The commutators which control the changes are made in three sizes, and the monogram itself comprises a collection of metal compartments each of which holds an incandescent lamp. It is possible to form any letter in the alphabet by means of the twenty-one compartments and lamps.

BALL BEARINGS.—Two interesting publications have been issued by the Hess-Bright Manufacturing Company, Philadelphia, Pa., on the subject of ball bearings as applied to industrial work. One shows the application of such bearings to woodworking machinery and the other to flour and feed-milling machinery. Ball bearings are, of course, applicable to all kinds of machinery and do not differ in their construction with different tools or machines, since a shaft is a shaft no matter where placed. Friction losses, however, while they cannot be avoided can be materially reduced by the use of anti-friction bearings, and those manufactured by the Hess Bright company are said to have a coefficient of friction of one-sixth of 1 per cent. This saving coupled with that made possible by the use of electric motors is an achievement worthy of any industry.

CREOSOTED CONDUIT AND TIMBER.—The Wyckoff Pipe & Creosoting Company, New York, manufacturer of creosoted conduit for underground wires, creosoted poles, cross-arms, anchor blocks and signal posts, poles, cross ties, fence posts, piles, wharf and bridge timbers, paving blocks, plank and all kinds of creosoted lumber, describes these various products in a catalogue just issued. The Wyckoff conduit is made of creosoted yellow pine, 4½ in. square on the outside, 8 ft. long and has a 3-in. hole through it. The sections are held together by mortise-and-tension joint. A creosoted top board 1 in. or 1½ in. thick and 4½ or 9 in. wide is placed on top of the run to protect it from workmen's picks. Concrete is not employed in laying the ducts, which are said to hold together like a bridge truss. The duct weighs about 5 lb. per linear foot.

BUSINESS NOTES.

MR. M. A. JOHNSON has been appointed by the Otto Gas Engine Works as representative in the Chicago territory, with offices at 537 South Dearborn Street.

GARWOOD ELECTRIC COMPANY.—Sales of small two and three-wire generators by the Garwood Electric Company in the last month aggregate 1500 kw.

THE WALPOLE RUBBER COMPANY and the Massachusetts Chemical Company are now located in the Brooks Building, at West Jackson Boulevard and South Franklin Street, Chicago.

COLONIAL ELECTRICAL AGENCY COMPANY, of San Francisco, Cal., agents for the Colonial Electric Company and the Economy Electric Company, both of Warren, Ohio, has moved from 576 Mission Street to the Board of Trade Building, 444 Market Street, San Francisco, Cal.

THE SCOTT ENGINEERING COMPANY, of 632 Wilson Building, Dallas, Texas, announces that it is prepared to do electrical or other engineering work after July 1. Dr. A. C. Scott, who is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, is president of the company.

IDEAL ELECTRIC NEW YORK OFFICE.—The Ideal Electric & Manufacturing Company, of Mansfield, Ohio, has opened a New York office at 50 Church Street, which is in the charge of H. J. Brewer. The new line of Ideal apparatus comprises standard frames, alternating-current and direct-current motors and generators, high-torque squirrel-cage motors, interpole motors and a new design of electroplating dynamos. Applications and specifications for apparatus may be submitted to the New York office by prospective purchasers.

MORRIS STREET-LIGHT STANDARDS.—The Morris Iron Company, 88 West Street, New York City, reports a large increase over the same period of last year in the sale of street-light standards. During the past two weeks orders have been received from Battle Creek, Mich., for fifty five-light standards; from Richmond, Va., for thirty-five five-light standards, and from Canajoharie, N. Y., for ten five-light standards. As an indication of the type in greatest demand, it may be noted that all of these poles have four pendent and one upright globe.

BRILLIANT LAMP PITTSBURGH OFFICE.—The Brilliant Electric Company, of Cleveland, Ohio, has opened a branch office at 15 Terminal Office Building, Pittsburgh, Pa. A large and well-assorted warehouse stock of lamps will be carried in connection with this office. Mr. Ralph O. Sperry, formerly with Jones, Beach & Company, electrical supply dealers of Philadelphia, will be district manager of the Brilliant Electric Company's Pittsburgh branch.

COAL-MINE ELECTRICAL PLANT.—The Ellsworth Collieries Company, which operates a large mining property at Ellsworth, Pa., will install a central plant for generating and distributing electric energy to its various mines. To this end it has ordered of the General Electric Company one 750-kw, 60-cycle, 2300-volt generator, driven by a mixed-pressure Curtis turbine; one 360-kw, 60-cycle, 2300-volt belt-driven generator, one motor-generator exciter, one belted exciter and switchboard. The mixed-pressure turbine will operate as a low-pressure turbine most of the time it is in service, taking steam from the mine-hoist engine, fan engine and engine driving the 360-kw generator in the power station.

MEXICAN GOLD MILL MOTOR INSTALLATION.—The Santa Rosa Mining Company, a subsidiary of the Exploration Company, of England and Mexico, located in the State of Zacatecas, Mexico, near Concepcion del Oro, is erecting a mill that will be electrically operated. Light and power is supplied from a gas-producer plant in which anthracite coal or charcoal is used as fuel. The gas engine will be connected by a belt to a 150-kw Westinghouse alternator. Switchboards, transformers, etc., and twenty motors have been installed. The tube mill is driven by a 60-hp motor; there are seven motor-driven direct-connected pumps for supplying water to the cyanide plant, and nine other motors are located at various places around the plant. A transmission line about 2 miles long supplies the energy for three motor-driven pumps, which control the water supply. All of the equipment has been purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., of Mexico City, which has furnished Westinghouse equipment throughout. The motors are of a new type which the Westinghouse company has brought out for especially heavy-duty service. When completed, this property will have one of the most modern equipments in Mexico.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 13, 1911.

994,712. ELECTRICAL INDICATOR; E. W. Bishop, Bakersfield, Cal. App. filed April 26, 1910. The indicator is intended for use with walking beams of pumps, and is so arranged that when in motion the walking beam opens and closes a circuit, thereby oscillating the indicator in synchronism with itself.

994,713. MECHANICAL MOVEMENT; T. A. C. Both, New York, N. Y. App. filed Jan. 5, 1911. Details relating to a quick-make and quick-break mechanism of an incandescent lamp socket.

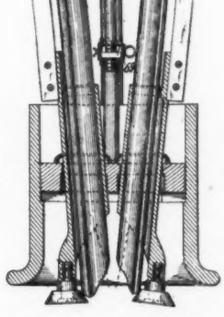
994,719. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed Oct. 25, 1901. The circuits are arranged to enable the central operator to make her calls without producing unpleasant sounds in the receiver at the substation, and to cause the calling signal to remain displayed until the call is answered by the operator.

994,744. BATTERY CONNECTION; S. J. Hall, Depew, N. Y. App. filed Feb. 28, 1908. The connector is composed of a short section of metal having a socket at one end to receive a soldered connector for a cell, the connector having an intermediate neck of such limited size as to retard the conduction of heat from one end to the other.

994,791. BRAKE FOR RAILWAY CARS; H. E. Saylor, H. S. Hedrock and F. P. Gladfelter, of Canal Winchester, Ohio. App. filed Aug. 2. 1910. The magnets of the brake can be energized, and the brakes can be set either at the will of the engineer on the locomotive or automatically when the train breaks in two. The brakes on each car are energized by means of a generator driven from the axle of the car, each car being independent of every other car in the train.

994,810. ELECTRICAL APPARATUS; G. Westinghouse, Pittsburgh, Pa. App. filed Dec. 29, 1905. Relates to the forced ventilation of rotating machinery. The apparatus is inclosed in a casing through which air is drawn by means of an exhaust fan, a partial vacuum being maintained around the elements to be cooled.

994,814. RAILWAY SIGNALING SYSTEM; H. C. Bennecke, Chicago, Ill. App. filed May 13, 1909. The system is designed for use on railways in which all the cars on the same track operate in the same direction. The arrangement is such that the operator of each car is notified when the line ahead of him is not clear, either by reason of a misplaced switch, the presence of another car, or other cause.



994,833.—Electric Arc Lamp.

994,818. RAIL BOND; W. B. Cleveland, Cleveland, O. App. filed June 23, 1909. The bond is made up of a flexible cable portion connected to two terminals consisting of sleeves fitted over the ends of the body portion and cold pressed so as to compact the ends of the cable strands together and present in effect a solid body.

994,826. METHOD OF TREATING MOLDS USED IN THE ART OF ELECTROTYPING; G. E. Dunton, New York, N. Y. In order to insulate a wax mold from its molding pan, a continuous coating is formed on the edges of the wax mold, the molding pan, and the outer marginal portions of the mold and the molding pan.

994,833. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed March 9, 1907. The electrodes are provided with ribs arranged to be in contact with conducting supports which form the terminal contacts for the lamp. The electrodes are so proportioned that the parts farthest from the arc, and by which they are supported, are consumed at a linear rate equal to the consumption of the main portion of the electrodes.

994,834. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed June 13, 1908. One of the electrodes is arranged similar to patent 994,833, while the other is movable with relation to the former.

994,835. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed June 22, 1908. A modification of 994,834.

994,836. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed June 23, 1908. The electrode support is provided with a rod and means for conducting current thereto, comprising a sleeve which incloses and carries the rod, means upon which the sleeve is pivotally mounted and a cut-out arm connected to the sleeve and partaking of the movement thereof.

994,837. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed May 1, 1909. Modification of No. 994,834.

994,846. THERMALLY OPERATED ELECTRIC TIME LIGHT; I. L. Kiser, St. Charles, Mo. App. filed May 6, 1910. The heat from the lamp filament expands a fluid contained within a tube, and thereby operates a switch to cut out the lamp after a predetermined time limit.

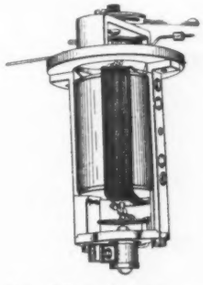
994,853. ELECTRIC SWITCH; J. K. Lux, St. Louis, Mo. App. filed May 26, 1900. Constructive details of a snap switch of the knife-blade type.

994,867. ELECTRICAL ADVERTISING DEVICE; B. A. Neagle, Durham, N. C. App. filed Nov. 17, 1910. Within a glass inclosure is placed an incandescent lamp, in the circuit of which is placed a switch automatically operated by the second-hand pinion of a clock.

994,871. METHOD OF MAGNETICALLY SEPARATING ORES; C. Q. Payne, New York, N. Y. App. filed March 15, 1911. The ore mixture to be separated is divided into separate groups by sizing it so that the particles in each group will be as nearly uniform in size as possible, each group being independently treated upon a separating surface, so formed that the particles acted upon by magnetic attraction are permitted independent positions, instead of massed positions of attachment.

994,908. PROCESS OF BONDING RAILS; W. B. Cleveland, Cleveland, O. App. filed June 12, 1909. The bond is of the stud-terminal type, and is attached to the rail by welding with electrical heat.

994,923. MEASURING INSTRUMENT; C. E. Holmes, Lynn, Mass. App. filed July 18, 1908. The combination with a cylindrical core forming part of a magnetic system of a moving coil having the form of a section included between parallel planes at different distances from and on opposite sides of the axis of a hollow cylinder larger than the core.



994,923.—Measuring Instrument.

994,952. ELECTRIC SWITCH; L. T. Rhoades, Mont Clare, Pa. App. filed Jan. 3, 1911. The switch is designed for use on automobiles, and is so constructed as to connect the battery and the magneto-generator in and out of circuit with the spark plugs of the engine.

994,957. MAGNETIC VIBRATOR; F. V. Smith, Floriston, Cal. App. filed Dec. 20, 1910. Details of a massage vibrator of the electromagnetic plunger type.

994,976. CONTROLLING ELECTRICAL CIRCUITS; E. T. Childs, Rosemont, Pa. App filed Dec. 21, 1907. Arrangements are made for shifting mercury vapor lamps from parallel to series connection without interrupting the current to any one lamp.

994,993. ELECTRIC MOTOR CONTROL; R. Fuller, Detroit, Mich. App. filed Sept. 9, 1908. The control mechanism is designed for use with electric trucks, and involves the use of a special generator driven at constant speed by a gas engine, and adapted to operate the propelling motors at various outputs.

995,000. OIL SWITCH; C. D. Haskins, Schenectady, N. Y. App. filed Nov. 19, 1906. Co-operating contact blades are so mounted beneath the oil and the containing vessel as to separate along their edges, and are of a sufficient length to extend the whole length of the vessel, and are arranged to form a diffuse arc when the circuit is opened.

995,025. MECHANICAL JOINT FOR VACUUM TUBES; D. McF. Moore, Newark, N. J. App. filed April 16, 1908. In order to prevent the heating of the joint made in glass tubes, a separate connecting tube is located at the joint so as practically to fill the bore of the tube, and thereby contract the electric discharge at the joint.

995,036. ELECTRICAL MEANS FOR AUTOMATICALLY CONTROLLING THE FLOW OF GASES OR LIQUIDS; A. F. Shepherd, Dayton, O. App. filed March 3, 1910. The flow of gas is regulated through a large number of valves, in order to relieve the switches of the strain due to breaking heavy currents.

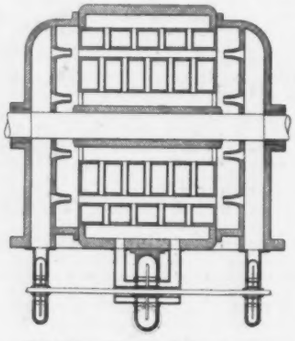
995,051. HELICAL HEATERS FOR TUBES; J. I. Ayer, Cambridge, Mass. App. filed Nov. 25, 1910. The heater member comprises a resistance coil and insulating plates having a series of lobes projected therethrough, the coil engaging opposite sides of the alternate lobes on each successive plate.

995,077. INCANDESCENT LAMP; M. M. Merritt, Middleton, Mass. App. filed March 23, 1906. The lamp is so constructed that it may not be refilled. A downward opening pocket is formed in the walls of the bulb, and in this pocket is placed a substance which will rupture the bulb by expansion when heated.

995,091. CONTROLLER REGULATOR; J. Y. Porter, Detroit, Mich. App. filed March 18, 1911. The regulator is provided with a mechanical device so that it cannot be advanced at too rapid a rate.

995,123. INSULATOR PIN; C. G. Ette, St. Louis, Mo. App. filed Aug. 31, 1910. The body portion is adapted to be connected to a support, and a removable head is adapted to be permanently connected to an insulator, and a separate screw-threaded device is permanently embedded in one of the parts and detachably connected to the other part.

995,126. SYSTEM FOR AMPLIFYING FEEBLE ELECTRIC CURRENTS; L. De Forest, New York, N. Y. App. filed June 20, 1907. Between the currents to be amplified and the signal-indicating device there is interposed a source of high-frequency electrical oscillations, and a circuit including an oscillating responsive device.



994,810.—Electrical Apparatus.

995,132. ELECTRIC STEAM GENERATOR; C. E. Griffing, Salt Lake City, Utah. App. filed Nov. 9, 1910. An electric heater is placed within a tank, and a spray of water is forced upon the electric heater by means of compressed air.

995,133. SECTION INSULATOR FOR ELECTRIC CONDUCTORS; W. G. Hamilton, Twickenham, England. App. filed May 6, 1910. The two end members are insulated from each other and from a central member, upon which a blade support is rotatably mounted, the flexible element being fastened to the blade support for operating it from a distance.

995,145. CURRENT-COLLECTING DEVICE; R. P. Jackson, Wilkinsburg, Pa. App. filed April 12, 1906. A third rail shoe having a pivotally mounted contact arm comprising two pivotally connected members, with resilient means for opposing pivotal movement between the members in either direction, and operating means connected to the joint between the members.

995,162. STORAGE BATTERY; A. E. Lawrence, San Marcos, Texas. App. filed Jan. 10, 1911. The plate is composed of one part graphite and nine parts of red lead, and has a metallic coating.

995,171. CONTROL OF SYNCHRONOUS MACHINES; H. W. Peck, Wilkinsburg, Pa. App. filed Oct. 3, 1905. The combination with a plurality of electric transmission circuits, a supply circuit and auxiliary apparatus for the transmission circuits of means for selecting one of the transmission circuits for connection with the supply circuit and for rendering operative only the auxiliary apparatus connected to the circuit selected.

995,184. TIME-LIMIT RELAY; A. B. Reynders, Wilkinsburg, Pa. App. filed Oct. 20, 1904. One side of a bellows connected to the movable core is provided with an air inlet valve, and the other side is provided with an escape valve, each of the valves being automatically opened and closed.

995,191. SAFETY TROLLEY; G. Sitka, Chicago, Ill. App. filed May 24, 1909. Grooved wheels are mounted on either side of the wire, in order to prevent the main running trolley wheel from losing contact with the wire.

995,203. ADJUSTABLE OUTLET FOR ELECTRICAL APPARATUS; W. T. Thomas, Glenside, Pa., and H. T. Paiste, Philadelphia, Pa. App. filed March 9, 1910. A reversible plate is mounted adjacent to an opening in the wall, and is provided with a laterally projected portion capable of entering the opening in the wall, there being an opening in the plate capable of being brought into registry with the opening of the wall.

995,204. THIRD RAIL FOR ELECTRIC RAILWAYS; J. N. Tomlinson, Vineland, N. J. App. filed Dec. 15, 1909. Supporting blocks formed of insulating materials are provided for the reception of the third rails, a trough surrounding three sides of the rails, roof strips being hinged to one side of the trough, with brackets secured to the blocks, and strips secured to the roof strips and hinged to the brackets.

995,213. ELECTRIC FOOT WARMER; S. Ballard, Temple, Texas. App. filed March 28, 1910. The foot warmer consists of an electric lamp, which may be used not only in the heating device, but also for supplying light for treating certain diseases.

995,221. AUTOMATIC FIRE ALARM; W. P. Britain and G. J. Packman, Westplains, Mo. App. filed May 7, 1910. Between outer and inner casings is placed a fusible contacting material, which forms a contact between the two cases when the temperature outside becomes higher than normal.

995,238. INCANDESCENT LAMP SOCKET; H. E. Evans, London, England. App. filed Dec. 29, 1910. A cord terminal electric connector constructed with separate individual insulating grips for the respective positive and negative cord conductors.

995,244. ELECTRIC PULL SOCKETS; E. H. Freeman, Trenton, N. J. App. filed Jan. 28, 1911. The pull socket comprises a body having a lateral segmental guide slot, a switch and switch-operating means, including a pull lever extending through the slot.

995,255. ELECTROMAGNET; W. Kaisling, Chicago, Ill. App. filed Aug. 1, 1908. The armature of the electromagnet is provided with a transverse groove, opposed bearings, a pin lying in the groove and extending beyond it into the bearings, and a clamped piece overlying the groove and pressing against the pin to hold it frictionally in place.

995,292. ELECTRICAL MEASURING INSTRUMENT; F. W. Roller, East Orange, N. J. App. filed July 3, 1909. The combination with the movable element of a threaded extension, and an eccentrically-mounted nut on the extension, the nut being slotted from the opening to one side.

995,294. SUBSTATION SELECTOR; H. O. Rugh, Sandwich, Ill. App. filed Nov. 13, 1909. Mechanical details of a selector used in connection with electric circuits when one station unites a number of substations with a central station.

995,328. COMBINED CIGAR CUTTER, LIGHTER AND ADVERTISING DEVICE; J. F. Davis and P. Lestrade, New Orleans, La. App. filed Dec. 12, 1910. The device consists of a cigar cutter, lighter and illuminated advertising sign, the means for lighting the cigars and illuminating, the sign being ignited through the medium of the action of the cigar cutter.

995,339. SPACE TELEGRAPHY; L. De Forest, New York, N. Y. App. filed June 20, 1907. In a system for developing a practically continuous train of electromagnetic waves of uniform amplitude, arc electrodes, a source of current connected in circuit with the electrodes, capacity and inductance, shunt electrodes and means for automatically moving the electrodes relatively to each other.

995,421. APPARATUS FOR AND PROCESS OF MIXING METALS; F. E. Canda, New York, N. Y. App. filed Dec. 29, 1906. A receptacle for molten metals is provided with a floor, and has projecting downward from the floor a crucible pit equipped with an electrode and an electric welding device.

The Following Patents of Earlier Dates Have Just Been Received from the Patent Office:

990,418. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 24, 1907. The tap comprises an insulating base having an opening to accommodate conductors, a lamp-receiving socket carried thereby, a plug extending from the base and a threaded outer contact rotatable with respect to the plug.

990,419. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 24, 1907. The outer contact member of the plug is rotatable thereon, and means are provided for conveniently grasping it so that when the device is applied to a stationary socket the outer contact may be screwed into the socket without rotating the device as a whole.

990,420. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 28, 1909. The tap is arranged so that the plug may be withdrawn with very little strain upon any part of the device, so that the danger of loosening the socket into which the device is screwed is minimized.

991,289. MULTIPLE PLUG SOCKET; L. H. Figgs, Los Angeles, Cal. Issued May 2, 1911. App. filed Oct. 30, 1909. The socket is so arranged that several lamps may receive energy through a single plug connection, each socket being removable from the main body independently of any other socket.

991,309. PORCH RECEPTACLE FOR ELECTRIC CONDUIT OUTLET BOXES; C. S. Homsher, Denver, Col. Issued May 2, 1911. App. filed Oct. 4, 1910. The receptacle comprises a body having chambers at opposite ends, an attaching device disposed in one chamber, and a screw passing through the wall between the chambers and connecjed with the device for holding it in position.

992,084. INCANDESCENT LAMP LOCK; C. W. Trulock, Los Angeles, Cal. Issued May 9, 1911. App. filed June 30, 1909. The plug socket member comprises a hollow screw-threaded plug member having a central terminal and a screw-threaded socket member rotatably carried within the plug member having a central terminal adapted to receive the screw-threaded base of an incandescent lamp.

992,306. CLUSTER LAMP SOCKET; N. Weeks, Richmond Hill, N. Y. Issued May 16, 1911. App. filed May 17, 1904. The socket consists of a finishing cap and a block of insulating material located centrally therein, and having lamp contacts attached thereto for a plurality of lamps, the block being supported wholly by the cap, and a suitable support with which the cap is movably connected.

992,636. INCANDESCENT ELECTRIC LAMP OR LIKE HOLDER; H. O. Beige, Halle-on-the-Saale, Germany. Issued May 16, 1911. App. filed Aug. 11, 1910. The holder is a lamp socket consisting chiefly of insulating material with the minimum of separate metallic parts.

992,971. MEANS FOR ATTACHING ELECTRIC WALL SOCKETS TO WALLS; C. T. McDonald, Oak Park, Ill. Issued May 23, 1911. App. filed June 30, 1910. The socket, which is adapted to be inserted through the aperture of the cap of an outlet box, is provided with a shoulder which abuts against the outer face of the cap, and which co-acts with a locking member projecting laterally from the socket body at the rear of the shoulder, and is adapted to engage against the inner face of the cap after the socket is in place so as to lock the socket within the aperture.

993,340. MECHANICAL MOVEMENT; T. A. C. Both, New York, N. Y. Issued May 30, 1911. App. filed July 2, 1910. Relates to details of the quick-make and quick-break switch of an incandescent lamp socket.

993,762. CLUSTER SOCKET; J. H. Dale, New York, N. Y. Issued May 30, 1911. App. filed May 11, 1910. The socket is of the ceiling type so arranged that the lamps inserted are connected in series, the object being to minimize the number of separate parts employed in building up the socket.

Eng. Lit.

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JUN 23 1911

Electrical World

VOLUME 57.
NUMBER 25.

NEW YORK, JUNE 22, 1911.

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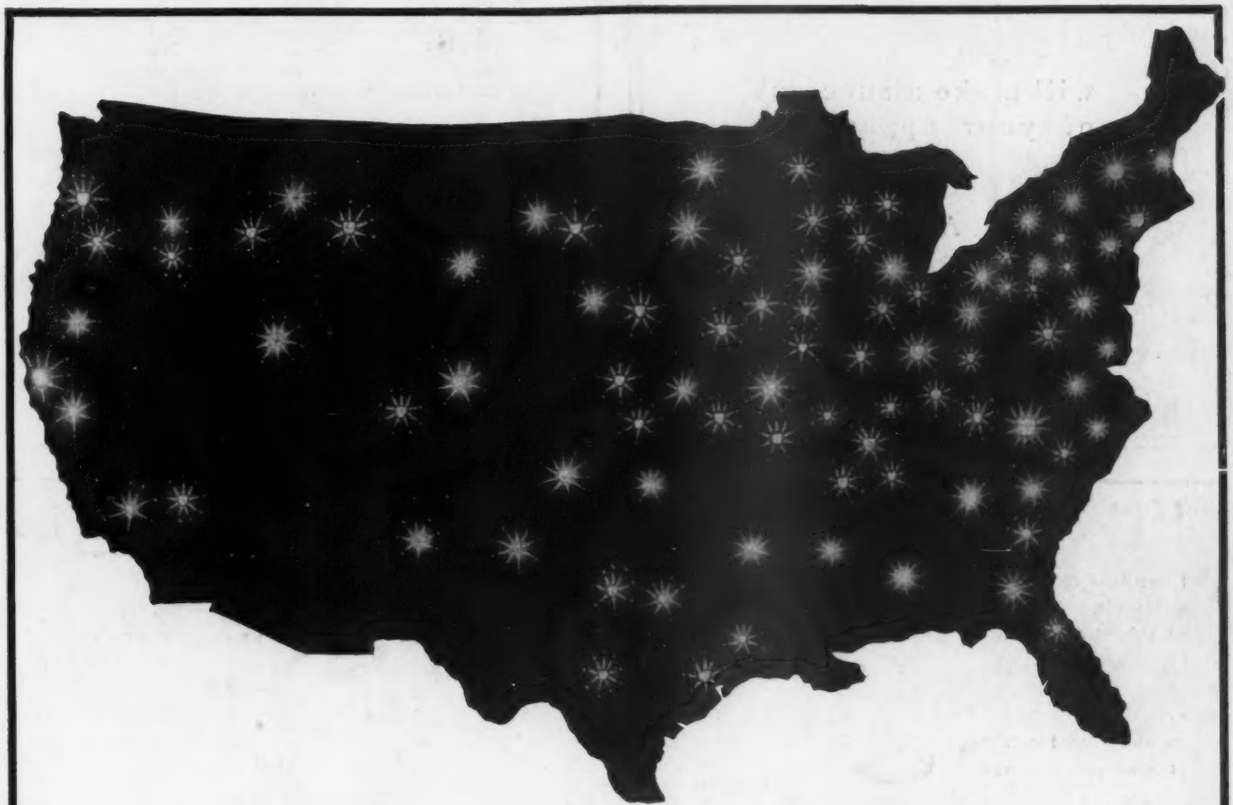

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Alphabetical Index and Classified Directory second page following reading

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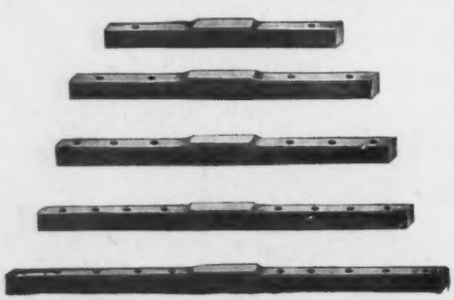

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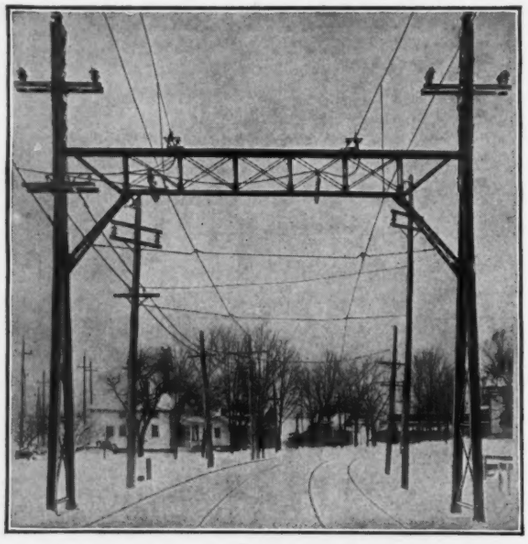

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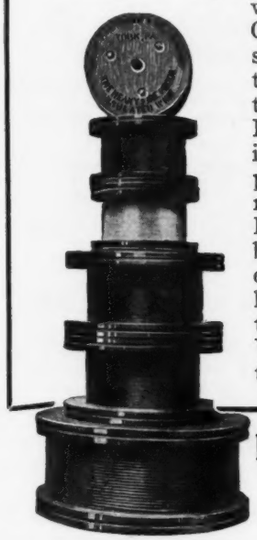

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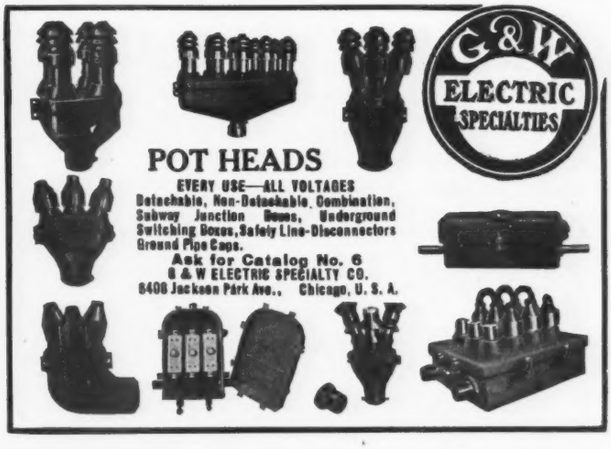

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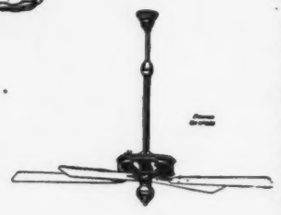

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The Hartford Faience Co.
HARTFORD, CONN.

If it's good enough to sell, it's good enough to advertise

The Copy Service Department of Electrical World can help you prepare advertising that will help you sell.

Electrical World, New York

ATLANTIC INSULATED WIRE & CABLE CO.
WIRES AND CABLES
FOR SUBMARINE, AERIAL, UNDERGROUND AND INTERIOR USE

FACTORY
STAMFORD, CONN.

120 LIBERTY STREET
NEW YORK CITY

INSULATING JOINTS
refer to display advertisement in the last copy of Electrical World. Send for printed matter on Insulating Joints, Dim-a-lites, Resistance Units.

Wirt Electric Specialty Co., Germantown, Pa.
Federal Electric Co., Chicago A. Hall Berry, New York

Manufacturers of HARD and FLEXIBLE FIBRE
For ELECTRICAL INSULATION and MECHANICAL PURPOSES
DIAMOND STATE FIBRE COMPANY
ELSMERE U.S.A. DELAWARE
Made in SHEETS, RODS, TUBES, WASHERS, DISCS and SPECIAL SHAPES
COLORS RED, GREY and BLACK. Write for Estimates

WINDING MACHINERY
FOR INSULATING WIRE
AMERICAN INSULATING MACHINERY CO.
N W cor. Hancock and Oxford Streets, PHILADELPHIA, PA.

What Does It Cost You To Renew a 35-Foot Pole?

Figure up the cost of the pole, the labor of setting it, and the work of changing over your cross-arms and wires from the old pole—you'll find it much less expensive to use

Orr Reinforcement

(Patented)

The material required by this process for a 35-foot pole costs a little over a dollar—unskilled labor can do the work as it is only necessary to attach the rods to the pole and place the concrete. Strong rods, stout wire mesh and concrete are applied to the pole base, where the decayed parts have first been chopped away, restoring the lost strength and practically doubling its life.

Write for detailed information and royalty terms.

PITTSBURGH REINFORCING POLE CO.

435 6th Avenue, PITTSBURGH, PA. 3

UNDERGROUND CONDUIT CONSTRUCTION

G. M. GEST

Executive Offices:
277 BROADWAY
NEW YORK

Cincinnati Chicago
San Francisco Montreal

THERE'S NOTHING SO GOOD AS

Trade Mark **LAVITE** Patented March 26, 1906

for any insulation. Insulation equal to glass. Stands any heat. Always the same and made exactly any shape or size. Ask for book of properties.

D. M. Steward Manufacturing Co., Chattanooga, Tenn.

An Advertiser in Our Classified Column Writes:—

We want to congratulate you on the results of our one time adv. which brought forth intelligent replies from all over the country and England.

Head Work Beats Hand Work

In Paragon Ground Cones we've done all the head work. All you have to do for a perfect grounding is just bore a post hole and drop cone in. Simple, easy to install. One man does the work of several. Costs little, never needs attention. Biggest, most progressive companies using them.

THE PARAGON GROUND CONE

consists of a hollow perforated copper cone, packed with fine charcoal, which attracts moisture, keeps ground always damp. Perfect ground.

Perforations afford ample discharge points.

No maintenance cost.

Hadn't you better do a little head work now and look into this? It means a big saving to your company besides increased effectiveness in your service.

If your jobber will not supply you, write us for prices and full information.

Paragon Sellers Company 150 N. Fifth Ave. CHICAGO, ILL.

Seattle, 520-4 First Ave., S. San Francisco, 544 Van Ness Ave.

Rector's Hotel

HABIRSHAW WIRE COMPANY

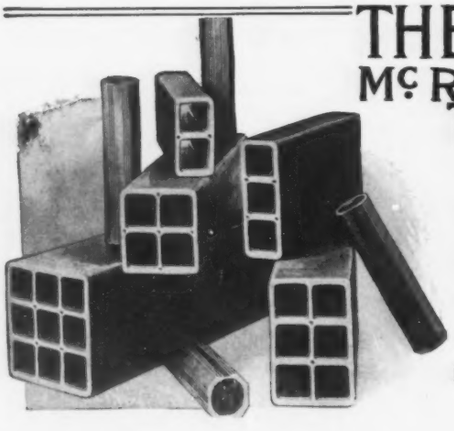
RECTOR'S HOTEL
NEW YORK CITY

Habirshaw Red Core
Installed Throughout

Wired by
THOMPSON STARRETT COMPANY
49 and 51 Wall St., New York City

OFFICES:
253 Broadway, New York City

WORKS:
Yonkers, New York



THE STANDARD FOR QUALITY
McROY — CONDUITS — CAMP
The Pioneer Manufacturers

Specify either of the above standard makes when writing your underground specifications.

Factories East and West, enable us to figure reduced freight rates, assuring you of the lowest delivered prices without sacrificing quality in any way.

Large stocks of both single and multiple duct constantly carried, thus insuring an early delivery.

Our conduits have been used for twenty-three years. Inquire about us in any city where conduits have been installed.

McROY CLAY WORKS
The Rookery, Chicago

H. B. CAMP COMPANY
New York Pittsburgh Chicago

A GOOD ADVERTISEMENT

requires a good product, a good advertising medium and good copy. If you have the first, we can supply the other two requisites.

ELECTRICAL WORLD
239 West 39th St., New York

Can't Separate in the Conduit
COPE CONDUIT RODS

T. J. COPE, 3244 N. 15th St. Philadelphia

Ask for the details of Cope Cable Rack and Conduit Threading Machine

FIBRE Sheets, rods, tubes, washers, etc. Special shapes promptly supplied.

MITCHELL-RAND MFG. CO.
ELECTRICAL INSULATING MATERIALS.
'Phone 936 John 1 99 John St., New York

SILK For Electrical Purposes
Silk for Insulating Finest Wire
ALL KINDS BRAIDING SILK
William Ryle & Co., 225 FOURTH AVE., Cor. 18th St. NEW YORK CITY

CONTRACTORS
save
Time and Money
by installing
Sprague Electric Flexible Steel Armored Conductors

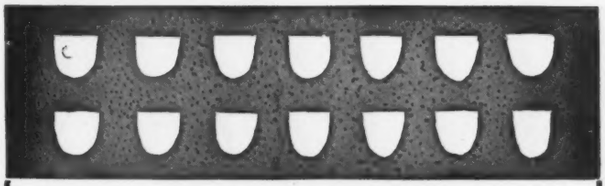
Twin Conductors, Type "BX"
and
Flexible Steel Conduit

Conduit Coil

THESE reduce the art of installation to absolute simplicity and eliminate trouble and expense.

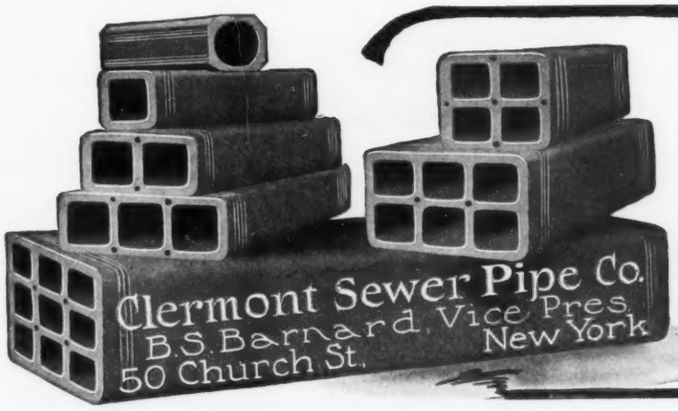
Catalogue No. 4363 free on request.

SPRAGUE ELECTRIC WORKS
Of General Electric Company
MAIN OFFICES
527-531 West 34th St., New York, N.Y.
Branch Offices in Principal Cities



Cut the Cost
and increase the reliability of underground wire and cable installation by using
One-Piece Conduit
It is built in the ditch, of ordinary concrete materials, with ordinary labor, and has many advantages not found in other types, among which are low first cost, ease of perfect inspection, absolute protection of cables and smooth continuous ducts.
Write for terms of royalty and data on cost of construction.

MONOLITHIC CONDUIT CO.
Chemical Bldg., St. Louis, Mo.



Clay Conduit Sewer Pipe
and
Superior Clay Products
"We defy the world in quality"

The Purchasing Agent of a large Railway System recently wrote:

"Our Master Mechanic says your sample of **P & B** Clear Baking Varnish beats anything he has used. Please ship us a barrel. If your price is right you can have our business."

Of course, we got the business, for our price *was* right. We have Insulating Varnishes for all classes of work, also the old **P & B** Compound and **P & B** Tape, such as you have always used.

THE STANDARD PAINT COMPANY
100 William Street, New York
Chicago Kansas City Philadelphia
Boston St. Paul Denver 5

ORIGINAL VULCANIZED FIBRE
SHEETS
For Electrical Insulation in Dynamos, Motors, Switchboards, Rheostats, Armatures. Also for Rail Insulation in Signal Systems.

All thicknesses up to 1½ inch carried in stock.

We manufacture the highest grade only.

Rods, Tubes, Washers, Discs and Special Shapes.

Write for prices, samples and further information.

AMERICAN VULCANIZED FIBRE CO., Wilmington, Del.
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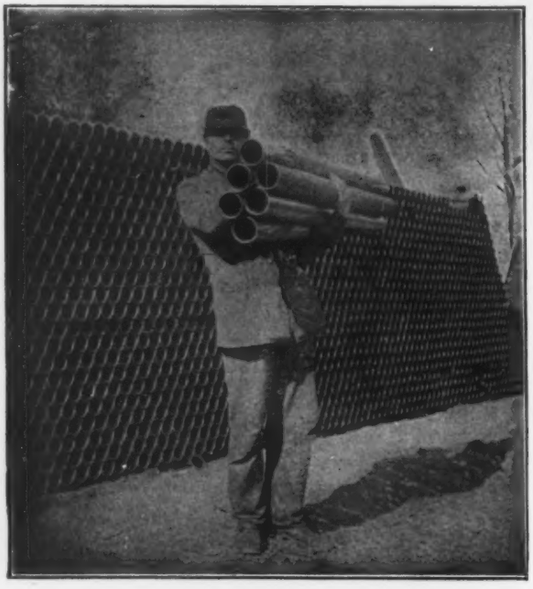

Carrying 30 feet 3" Socket Joints.

Orangeburg Fibre Conduit

("Admitted to be the best Fibre Conduit.")

Made with four styles of joints: socket, sleeve, screw and "Harrington," with bends and fittings for same.

Is The Lightest Conduit Made

(3" socket joint 1.2 lbs. per foot.)

hence the freight and cartage charges are reduced to the minimum.

Send for The Conduit Book

The Fibre Conduit Company

New York, 103 Park Ave.
Chicago, 1741 Monadnock Bldg.
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Winnipeg, Can., Tri-Provincial Supply Co.

Main Office and Factory:
Orangeburg, N. Y.

Pierson-Roeding Co., San Francisco, Cal.
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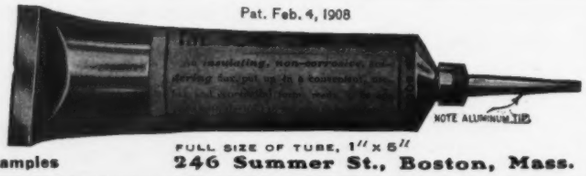
Insulated Staples
5 Sizes
Pat. Nov., 1900

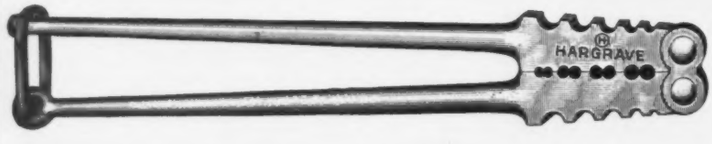
BLAKE Specialties

STAPLES best for wiring.
TUBE FLUX best Flux for soldering.



FULL SIZE OF TUBE, 1" x 6"

BLAKE SIGNAL & MFG. CO. Write for Samples **246 Summer St., Boston, Mass.**

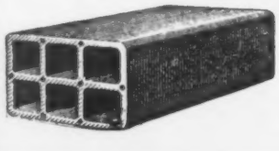


Splices?

They're easy, even with the heaviest wires, when you use the Hargrave Patent Splicing Clamp. It has a grip like a bulldog. Takes any sized wire.

SEND FOR CATALOG. Send four cents to cover postage.

The Cincinnati Tool Co. Cincinnati Ohio 2



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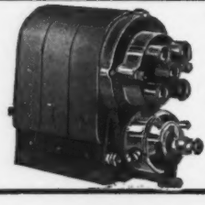
Single or Multiple. Any quantity. Quick delivery. Write for prices.

American Sewer Pipe Co.
AKRON, OHIO



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261 Walton Ave. New York

Vacuum Drying and Impregnating Machines

Manufactured by

Buffalo Foundry & Machine Co.
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Cannot Damage Metal

U. S. Metal Polish is easily applied, work quickly and produces a lustre that lasts. Established 16 years. Agents and dealers everywhere.

3 oz. box, 10 cents 5-lb. pail, $1.00. Sample Free

GEO. W. HOFFMAN, Manufacturer
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Why Waste Money on Inferior Protection?

Why buy expensive circuit breakers with their heavy, bulky, complicated construction and noisy operation, when for a small fraction of their cost you can obtain " Noark " Enclosed Fuses ? These fuses are light in weight and easy to install, occupy less than one-quarter the amount of space on the switchboard and give better protection.

"NOARK" Enclosed Fuses

operate as their name implies—with "no arc" or flash—and with no noise. They are absolutely reliable in operation, automatically indicate when blown, and being "National Standard," are interchangeable.
Write nearest branch for catalog.

H. W. JOHNS-MANVILLE CO.

MANUFACTURERS OF ASBESTOS AND MAGNESIA PRODUCTS

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POLES

Idaho Red Cedar
Resident Producers

SANDPOINT, LUMBER & POLE CO., Ltd.
SANDPOINT, IDAHO

POLES

WHITE AND IDAHO CEDAR

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You Can Always Be Sure of the Best

IF YOU WILL ALWAYS SPECIFY

Dunbar Springs

Small Springs made from sheet steel or steel and brass wire

THE DUNBAR BROTHERS COMPANY

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24 Cedar Yards—Idaho, Wash. & B. C.

Western Lumber & Pole Co.

Main Office: Electric Bldg., Denver, Colo.

PLATINUM

Scrap Purchased

CONTACTS OF ALL FORMS
WIRE FOR WIRELESS TELEGRAPHY
RESISTANCE WIRE
WIRE AND SHEET FOR ALL PURPOSES

AMERICAN PLATINUM WORKS
NEWARK, N. J.

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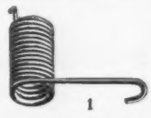
of every description from flat stock or wire. We make special springs to the customer's order only. Send us a sample or sketch and let us quote you.

Special Screw Machine Products
up to 7/8" diameter.

Ask for booklet 5-C giving full information.

Established 1857
THE WALLACE BARNES CO.
Bristol, Conn., U.S.A.



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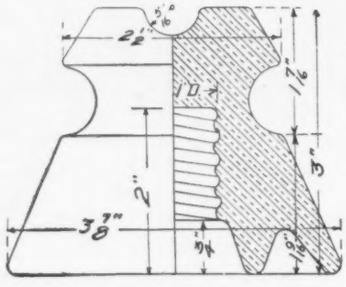
Thomas Insulator No. 1010



Line Voltage 5,000
Dry Test Voltage 20,000
Rain Test Voltage 12,000

The R. Thomas & Sons Co.

Established 1873 Incorporated 1892
Main Office, EAST LIVERPOOL, O.

FACTORIES:
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SALES OFFICES:
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5

"Pittsburg"

Insulators

meet every requirement of the most severe service, and are noted for solidity, evenness of body and uniformity of glaze.
Made in 150 designs for all voltages from 4,000 to 200,000.

Write for Catalog No. 2.

The Pittsburg High Voltage Insulator Co.

DERRY, PA. 2

WITH OR WITHOUT DRIP POINTS

Trade
BROOKFIELD
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GLASS INSULATORS

THE STANDARD FOR 45 YEARS

THE BROOKFIELD GLASS COMPANY

MANUFACTURERS

2 Rector Street NEW YORK

Transmission Line Success

depends largely upon how the insulators will act in wet weather.

Hemingray Insulators

with

teats on the petticoat

prevent moisture from creeping from insulator to pin. Specify Hemingray.
Booklet on request.

HEMINGRAY GLASS CO.

Covington, Ky. (3) Muncie, Ind.

THE INSULATOR BOOK

SOME FRANK CHAPTERS

Insulator Testing

We find that the fewer insulators tested at one time the higher the *apparent* voltage necessary to "flashover" which gives a spectacular but small dynamic effect, whereas a larger number of insulators tested at one time requires an equally high voltage to flashover, but on account of the large capacity involved gives surges and actual dynamic effects that DO DAMAGE and approximate line abnormal conditions.

Further find that when we let this large number of insulators under test flash over we further increase the destructive effect, similar to line "spills."

We mean by small number of insulators, one to 25: we mean by a large number, 150 to 200—the "Victor" method, another item that accounts for the permanency of transmission lines erected on "Victor" Insulators.

If we were disposed to "put on the soft pedal" and "slip through" the test with least hardship on the insulators we should test one insulator at a time and use as low K.W. transformer as might be.

Copies of The Insulator Book will be gladly supplied by THE LOCKE INSULATOR MFG. CO., VICTOR, N. Y.

BY DISPENSING WITH THE CROSS ARM FOR PARTY LINE SECONDARY WIRES, and using the PEIRCE SECONDARY RACK, you will reduce first cost, increase strength, reduce inductive drop, simplify service wiring, decrease hazard, and reduce maintenance.

Ask for Bulletin 110

HUBBARD & COMPANY
Pittsburgh
New York **Chicago**
Everything in Pole Line Hardware

CLARK Insulator Clamps, Twist Splice Connectors, Split Tinned Connectors

This cut is of our Standard Type A Clamp (Patented).

Cast from Copper-Bronze or Malleable Iron, galvanized or sherardized.

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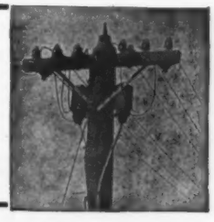
Clark Elec. & Mfg. Co.
149 Broadway
New York

Hard Porcelain
For Electrical Specialties
IMPERIAL PORCELAIN WORKS
TRENTON, N. J.

Ultimate Economy
under actual service conditions has been proven by
COLONIAL POT HEADS
All porcelain, two piece, brown glaze, with insulating compound that positively cannot leak in service up to 6600 volts, tested to 30000. Let us send you full details of the cheapest and best pot head made.
Colonial Sign and Insulator Company' Akron, Ohio



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TRENTON, N. J.

ATLAS PIPE HANGERS
are cheaper than pipe straps
Write us for catalogue and discounts
W. R. OSTRANDER & CO.
NEW YORK **BROOKLYN**

Continued High Temperature

does not affect the insulating value of

Packard

INSULATING CLOTH

It remains flexible and tacky for good long life service.
Try the liberal sample we will send you,—subject it to heat in comparison with others, and note the superiority of Packard cloth.
Packard Tapes, Varnishes and Transformers.

THE PACKARD ELECTRIC CO.
312 Dana Ave., Warren, O.

Duncan Transformers fulfill every requirement

that everyday service can impose upon them.

High all day efficiency.

Prominent in low core loss.

Persistently withstand the ravages of lightning.

Tried under extraordinary conditions with uniformly satisfactory results.

Let us send you Duncan Transformer and Meter literature.

Duncan Electric Mfg. Company
Lafayette, Indiana

PEERLESS TRANSFORMERS

Silicon Steel Cores.
Steady all-day-long uniformly high efficiency always.
A few in stock will enable you to connect up your new "contracts" with expedition.
Let us send you the details.

The Enterprise Electric Co., Warren, O.

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John Deere Export Co., New York City.
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Erner Electric Co., Cleveland, Ohio.
J. G. Schaff Electric Co., of Chambersburg, Pa., and Hagerstown, Md.
Parrott & Co., San Francisco, Cal.
Barden Elec. Mac. Co., Houston, Tex.
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PITTSBURGH TRANSFORMERS

Pittsburgh Transformer Company

Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pa.

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Does Your Plant Pay a Dividend?

Would You Consider a Remedy?

It Will Pay You to Write Us

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HEMMING INSULATION

GUMMON REG. U.S. PAT. OFF.

FIREPROOF HEMIT INSULATION

HEAT PROOF TEGIT INSULATION

Why not have your MOLDED INSULATING PARTS

HEAT PROOF?

It includes every other desirable quality when you

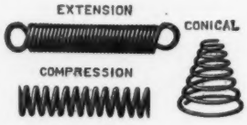
ORDER Hemming Insulation

Hemming Manufacturing Co., GARFIELD, N. J.

WIRE SPRINGS OF EVERY DESCRIPTION

Manufacturers of all kinds of Round and Flat Wire, Tempered and Untempered. Springs for Machinery, Rolling Shutters, Motors, Etc.

Fine Springs a Specialty



Write for booklet.
Please mention this paper.

CARY SPRING WORKS
240-242 West 29th Street
NEW YORK

1

ALL PORCELAIN
used in the manufacture of

Freeman Sockets

receptacles, rosettes, switch-bases, etc., is made in our own pottery works. Uniformly high and dependable quality is therefore assured in Freeman products.

Let us send you full details and quotations that will assuredly interest you.

Bracket or Fixture Weatherproof Socket No. 155

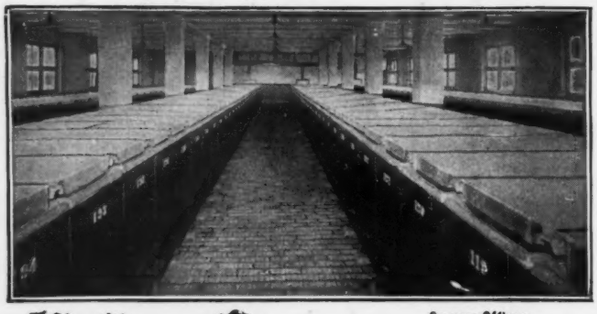
E. H. FREEMAN ELECTRIC CO.
TRENTON, N. J.

3

A Gould Battery

was selected for the Detroit River Tunnel System, current being supplied by Detroit Edison Company on maximum demand basis of 800 amperes. The battery is capable of supplying approximately 90% of working load for peaks of short duration.

Write for full information.



Sales Offices:
SAN FRANCISCO: 605 Atlas Building
CHICAGO: The Rookery
BOSTON: 60 State Street

Gould Storage Battery Co.

General Offices:
341-347 Fifth Avenue, NEW YORK CITY
Works:
DEPEW, New York 5

Cat. No. 2

TRUMBULL "JUNIOR" BATTERY SWITCHES

For use with gas engines. All parts made of copper. No iron screws. Very compact. Heavy insulation on handle. Made to stand hard usage. Blade cannot fall out of Hinge even if screws are removed. Very easy to fasten wire. All holes are drawn, giving large amount of screw thread. Can be fastened on metal support without danger of short circuit.

Get Circular

THE TRUMBULL ELECTRIC MFG. CO.
PLAINVILLE, CONN.

THERE'S PROFIT IN THE SMALL RESIDENCE

One of the biggest Central Station opportunities today is the INTENSIVE cultivation of the market. Instead of extending your lines and increasing your investment, develop the small residence customer and get all the profit the present lines can give.

It's simply a question of the right position.

Flat rates, with the EXCESS INDICATOR, are both attractive to your small residences and SAFE for you.

Let us send you the names of forty Central Stations which have found the EXCESS INDICATOR both a profitable means of getting business and a means of getting a profitable business.

EXCESS INDICATOR COMPANY 105 WEST 40TH ST., NEW YORK

"I am advised by Dr. ....., Professor of Chemistry of the ..... University, that you are putting out a Graphite Lubricating Preparation, which is the very finest thing of the kind he has ever seen."

This refers to

OILDAG

When Professors of Chemistry admit Oildag is a superior lubricant, it is time Power Station men realize its worth, particularly when Oildag is effecting a saving of approximately 60% in cylinder oil in one station.

ARE YOU ALERT TO YOUR POSSIBILITIES?

You must be interested. Send for Booklet 416 E.

International Acheson Graphite Company
Niagara Falls, N. Y

General Agents for Oildag, made by Acheson Oildag Company. 4

Battery Testing Instruments

That are well made and accurately calibrated. Watch type—light weight. In leather case for carrying.

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QUEEN

ELECTRICAL MEASURING INSTRUMENTS
PHILADELPHIA

SALOM ISOLATED ELECTRIC PLANT

brings city-convenience to you in the country Engine run once a week stores enough electricity to light an average home for a whole week. Write us for complete information.

NIAGARA LEAD & BATTERY CO., Dept. J, Niagara Falls, N. Y.
New York Philadelphia Chicago

WILLARD STORAGE BATTERIES

FOR ALL PURPOSES
Manufactured by
The Willard Storage Battery Co.
Cleveland, Ohio

ELECTRIC LIGHTING PLANTS for SUMMER HOTELS

Now is the time to sell and install Isolated Electric Lighting Plants for summer hotels, summer camps, suburban homes, etc., in districts where Central Station current is not available. Plants can be easily and quickly installed, and we have these plants in stock ready for immediate shipment. A complete plant consists of a small gas engine, a dynamo, a switchboard and a storage battery.

The "Chloride Accumulator"

used with these plants is exactly the same type of battery furnished for the large electric lighting companies, electric railways, etc. These plants give a full 24-hour service by only an occasional running of the engine to charge the battery. Dealers and contractors will find this very profitable business. Any Sales Office will furnish complete information.

THE ELECTRIC STORAGE BATTERY CO.

New York, St. Louis, Boston, Cleveland, Chicago, Atlanta, PHILADELPHIA, PA. 1888-1911, Denver, Seattle, Portland, Ore., Detroit, Los Angeles, San Francisco, Toronto

THE "National" STORAGE BATTERY

In every line of product there is a name that by virtue of proven excellence year after year is an accepted hallmark for quality.

The **"National"** is a hallmark in the battery world because it is manufactured by a company whose purpose it is to produce a battery of such a character that it will fulfill all the requirements of battery service with exceptional success. For any service—stationary or vehicle.

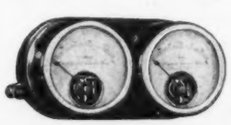
The United States Light and Heating Company

General Offices: 30 Church Street, New York

Factory: Niagara Falls, N. Y.

Sales Offices and Depots

NEW YORK, BOSTON, BUFFALO, CLEVELAND, DETROIT, CHICAGO, ST. LOUIS, SAN FRANCISCO



A distinguishing, we might almost say exclusive, feature of the

HOYT
Line of
Ammeters and Voltmeters

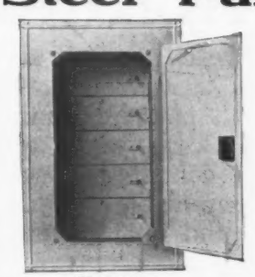
is their extreme flexibility, adapting them to practically every use required in modern practice.

Ask for Bulletin E.W.

Hoyt Electrical Instrument Works
Penacook, N. H.

Sales Offices:
164 Summer Street, Boston, Mass. 136 Liberty Street, New York
80 Michigan Avenue, Chicago Ill.

Sectional Steel Panel Boxes



No. 4162

have so many good points tied up in the one thing it will pay you to look into their make-up and price. We make all kinds and sizes for either Flush or Surface Work, Panel Cut-outs, Plug Cut-outs and Panelettes. Our bulletin, "Paistery," tells all about the new good things. Do you get it? What about a catalog? Let us know.

H. T. PAISTE CO., Philadelphia, Pa.
New York Boston Chicago 10

Engine Tachometer

"THE INDUSTRIAL LINE"
Indicating and Recording

Gauges, Thermometers
Pyrometers, Tachometers
Specify "Industrial" Efficiency Instruments
Send for General Bulletin A C 44. 3

THE INDUSTRIAL INSTRUMENT CO
New York Foxboro, Mass., U. S. A. Chicago

Design No. 37902

Send for Folder 19

The Morris Iron Co.
88 West Street, New York

THE MONITOR AUTOMATIC

Motor Starters and Controllers

No Dash-Pot
No Sliding Contacts
No Voltage Magnets
No Fixed Time Element

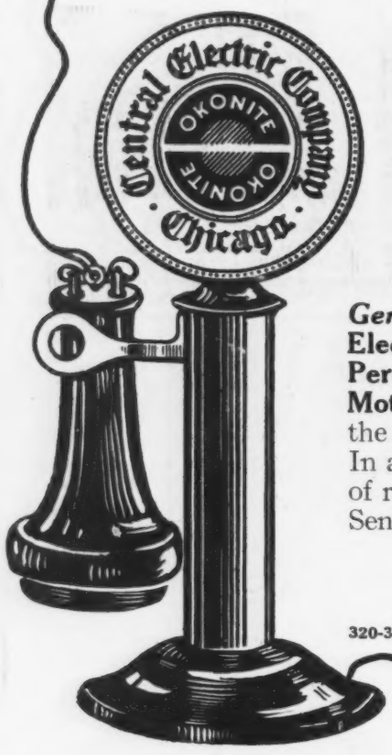
Monitor Controller Co. 106 South Gay Street Baltimore

IF the best costs no more
YOU naturally want the best.

Insulated CROSS Staples

are best, with new superior features.

James Goldmark (General Sales Agt.)
81 Warren St., New York 3



Electrical Supplies

The Telephone at Your Elbow is not more satisfactory and reliable than the **Central Service.**

We ship immediately all orders for:—

General Electric and ***Diehl*** **Fan Motors, *Pelouze-Central* Electric Irons—Chafing Dishes, Toasters** and **Disc Stoves, Percolators, *General Electric*** and ***"Bissell"*** **Sewing Machine Motors**—as well as other summer specialties so popular during the hot months.

In addition to this we carry large and well appointed stocks of regular *Electrical Necessities* ready for immediate deliveries. Send us your trial orders and test our reputation as

"THE HOUSE OF SERVICE."

Central Electric Company,

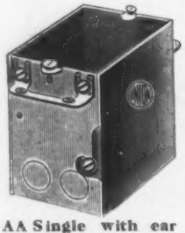
320-322-324-326 S. FIFTH AVENUE - - - - - - - CHICAGO

NO USE TALKING

"Union" Sectional Switch Boxes are Superior to One-piece Cast or Drawn Boxes in that you don't have to tie up your money in Solid Boxes when all you need to have a complete stock is the single box with removable side and spacers and you can build up into any number of Gangs.

Surely this is a Money Saver

You don't even have to take screws out to remove side — a time saver. Simply loosen screw and insert spacers.



AA Single with ear adjusted for new work

Made in depths from 2" up to 3½"; equipped with reversible and sliding ears.

Patented April 2, 1907

AA Spacer with "C" Ear regularly furnished

CHICAGO FUSE MFG. CO.

1014 W. Congress Street CHICAGO

1 Hudson Street NEW YORK

BAKELITE

(Reg. U. S. Pat. Office)

The Synthetic Insulating Substance

Why use resinous compounds when Bakelite Impregnated Coils withstand a temperature of 500° F.

Withstands oils, steam, solvents and chemicals. High Dielectric Strength. Ask us about other applications.

GENERAL BAKELITE CO.

100 William St. New York

Wagner Electric

Manufacturing Company, St. Louis, Mo.

ELECTRICAL INSTRUMENTS OF PRECISION

Wagner Instruments have from the start had distinctive features commending them to users. The Wagner Company was the first to supply horizontal edgewise alternating instruments, the first to supply "dead beat" alternating instruments and the first to supply illuminated dial alternating instruments.

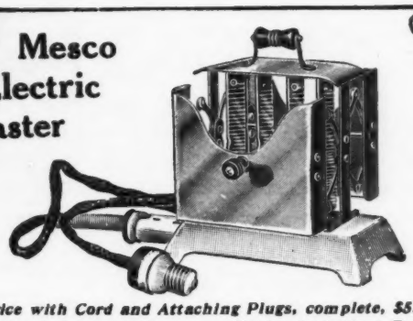
The Most Complete Line of electrical instruments offered to-day is offered by the Wagner Company.

Wagner Quality

SINGLE-PHASE MOTORS
POLYPHASE MOTORS
A. C. GENERATORS
TRANSFORMERS
INSTRUMENTS

MESCO MESCO

Mesco Electric Toaster



Price with Cord and Attaching Plugs, complete, $5.00

Low Current Consumption. Mechanical Heat Regulator.
Solid Porcelain Base. Highly Polished, Nickel-Plated Brass.
Not the Cheapest, But the Best.

Manhattan Electrical Supply Co.

NEW YORK, 17 Park Place CHICAGO, 188-188 Fifth Ave.

For Shallow Switches

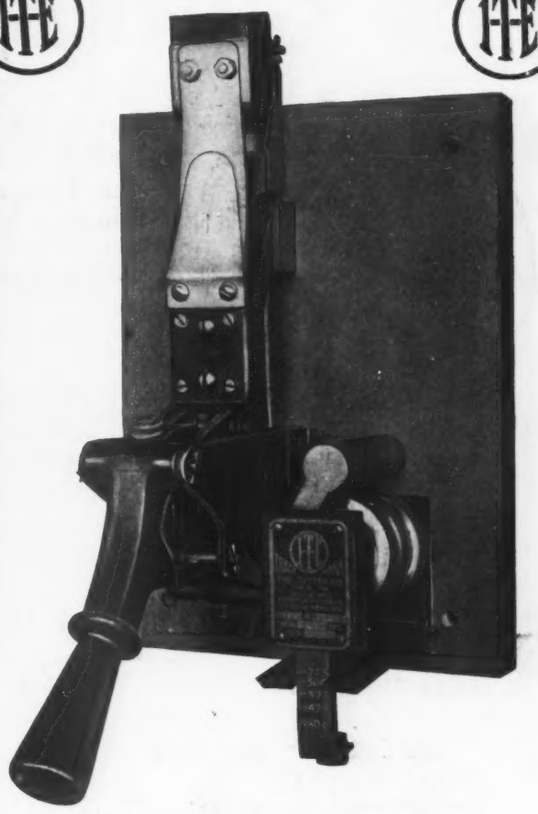
of any standard make

Bossert New Unit Box
(Patented)

is highly economical. Reversible ears instantly adapts it for old or new work.
A new feature of the original, unbreakable stamped steel box.

Only 2" deep, 2" wide and 3¼" long. Ready for immediate shipment in black enamel or galvanized.
Other sizes ready in 30 days. Ask us for details.

The Bossert Company, Utica, N. Y.
Successors to the Bossert Electric Construction Company.



TYPE "W" SINGLE-POLE, PLAIN OVERLOAD TYPE FOR THE PROTECTION OF MOTORS. BUILT IN CAPACITIES UP TO 400 AMPERES FOR 650 VOLTS OR LESS. DIRECT OR ALTERNATING CURRENT

Ten thousand times we have said that the I-T-E Circuit Breaker was the best piece of apparatus of its kind on the market. This is a broad statement and it is much more easily made than to tell why it is the best. We have endeavored to do so, however, in a book recently published entitled "Protection to Motors and Motor Driven Tools." We will send you this book on receipt of application. We have already distributed 20,000 copies. If you have one consult it; if you want one ask us for it.

THE CUTTER COMPANY
PHILADELPHIA

The Contact Resistance of Shawmut Fuses and Cut-Outs Is Negligible

—they are not only made and fitted with care, but all contact parts are of pure copper.

We take pardonable pride in the indicators, too. A good fuse is of primary importance and a good indicator of secondary importance —but it is important that both of them shall be good, although it is true that a good fuse with a poor indicator is much better than a poor fuse with a good indicator, because the active element of the combination is the fuse.

In Shawmut Fuses all three elements—fuse, indicator and contacts — are correct, and proven so by test.

Your dealer has them, or can get them for you.

Condit Electrical Mfg. Co.

Manufacturers of Electrical Protective Devices

BOSTON, MASS., U. S. A.

New York City, 3 West 29th St.
Chicago, Ill., 627 West Jackson Blvd.
Atlanta, Ga., 702 Empire Building.
Denver, Colo., 1621 17th St.
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What Do You Think of a Time Limit Relay

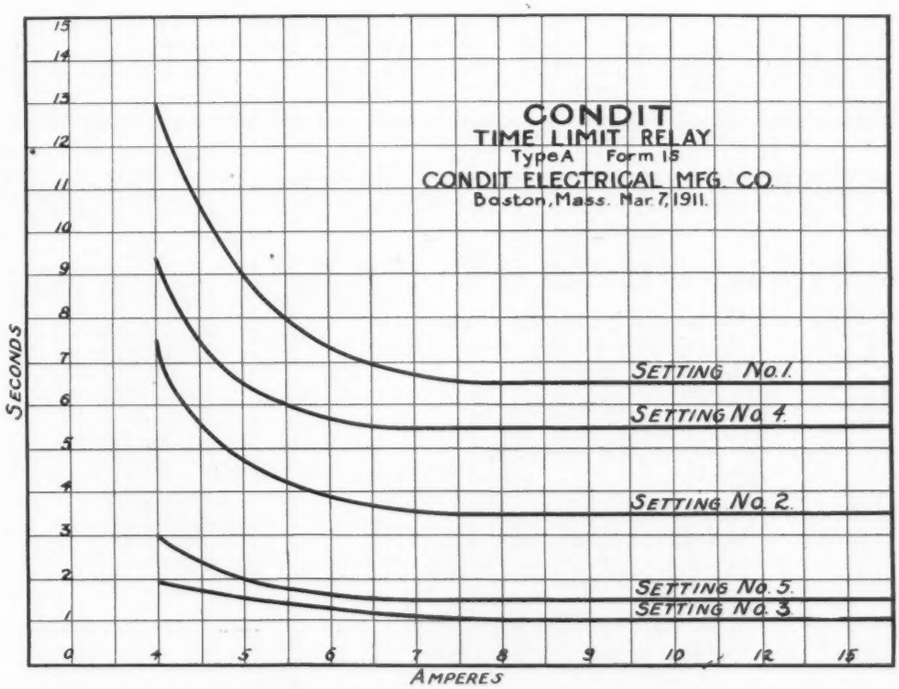
for the protection of your selectively set stations that will give you a curve like this without the use of bellows, fans or dash pots?

It is almost human in its action; inverse for part of the time when inverse action is needed, and definite for the rest of the time when definite action is needed.

If you equip your stations with this relay, a short circuit only shuts down the feeder on which the trouble happens in your entire system.

We are specialists in electrical protective devices. No matter what your problems are, put them up to us. If our regular line doesn't include a device that will meet your requirements, we will build one that will.

Write for catalogs.



Condit Electrical Mfg. Co.

Manufacturers of Electrical Protective Devices

BOSTON, MASS., U. S. A.

New York City, 39 Cortlandt St.
Kansas City, 618 Dwight Bldg.
Pittsburg, Pa., 219 Lewis Block.
Philadelphia, Pa., 1011 Mutual Life Bldg.
Chicago, Ill., 627 West Jackson Blvd.
San Francisco, Cal., 766 Folsom St.

Denver, Colo., 1621 17th St.
Atlanta, Ga., 421 Wesley Building.
Buffalo, N. Y., 41 East Eagle St.
Seattle, Wash., 425 New York Block.
Los Angeles, Cal., 551 So. Los Angeles St.

Northern Electric & Mfg. Co., Limited, Montreal.
Northern Electric & Mfg. Co., Limited, Toronto.
Northern Electric & Mfg. Co., Limited, Winnipeg.
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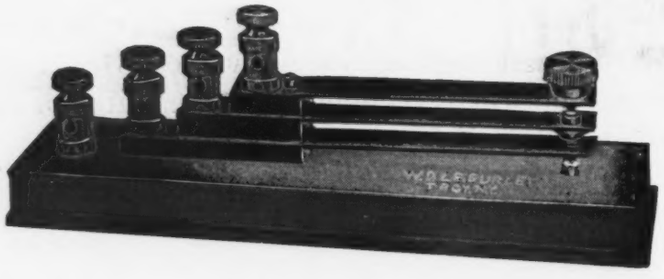
The Positive Quick Closing of Two Circuits, Simultaneously

is best accomplished by means of

The Gurley Double Contact Key



The long, hard rolled German silver springs are so mounted as to be of equal length, giving an extremely easy, even touch.
Furnished with silver or platinum contacts.
Ask for our catalog of Laboratory and Electrical Testing Apparatus.

W. & L. E. GURLEY, TROY, NEW YORK

2

L & N DIAL DECADE SET

A High Grade Portable Instrument

Resistances Wound on Metal Spools

All resistances are wound on metal spools, so that the maximum carrying capacity of the coils is increased.

The accuracy of the adjustment of the coils is 1-20 of 1 per cent. for the bridge coils, and 1-10 of 1 per cent. for the rheostat coils.

The coils are wound with Manganin wire so that ordinary changes of temperature do not decrease their accuracy.

Full description sent upon request.

THE LEEDS & NORTHRUP CO.
4903 Stenton Ave. Philadelphia

IDEAL ANNUNCIATOR

Gives Less Trouble and Better Service Than Any Made!

This is largely due to improvements being made constantly since its advent 18 years ago.

We carry the improved designs in stock and will make up specials to order.

Ideal Annunciators are made for either alternating or direct current use.

Write us for special proposition

ENGINEERING PRODUCTS CO.
SUCCESSORS TO HEATH ELECTRIC CO.
4 **Detroit, Mich., U. S. A.**

Motor Starters **Controllers**

Graphite Compression Type

Allen-Bradley Co.,

MILWAUKEE, WISCONSIN

Direct Current **Alternating Current**

Over Half the Readers

of the advertising pages depend upon illustrations to attract them. Are your advertisements "attractive?"

Type K3 Multiphase Meter with Glass Case.

Fort Wayne
Multiphase
Watthour Meters

have more special advantages than any other on the market, such as

Absolute protection from effects of both external and internal fields.

May be used without current transformers up to 150 amperes capacity.

Absolutely dust and tamper proof.

Tobin Bronze shaft, removable pivot, **diamond jewel**, spring top bearing and micrometer magnet adjustment.

High torque, small losses in current and potential circuits

These are only a few of the points that, as an electrical man, you realize are essential in the really superior meter. If you want to get the others as well as the reasons why Fort Wayne Meters enjoy the reputation they do, send for Bulletin 1129.

FORT WAYNE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY.
"WOOD" SYSTEMS

1609 Broadway, Branch Offices: All Large Cities. **Fort Wayne, Ind.**

The Modern Speed Indicator

The Hopkins Electric Tachometer consists of a small direct current magneto and an indicating meter calibrated in revolutions per minute. The two parts of the system are connected by a two-wire armored cable which carries current from the magneto to meter mounted on wall, switchboard or anywhere else you want it.

Magneto can be arranged for use like an ordinary portable tachometer, or for stationary service; gear driven, belted or directly connected as the case may be. Also arranged for motor boat engines.

HOPKINS ELECTRIC TACHOMETER

"No Flexible Shaft"

There is nothing about the Hopkins Electric Tachometer to get out of order. No joints or parts to wear and cause lost motion—accuracy is unaffected by changes in temperature—reads absolutely steady at all speeds.

No calibration curves are needed with the Hopkins Electric Tachometer—scale is uniform over entire range. It is the only tachometer you can dependably calibrate without laboratory facilities. Once calibrated, it can be used as a standard for other speed indicators.

Instrument illustrated is the Model S, special stationary tachometer, for use on newspaper printing presses, the scale being calibrated from 0 to 40,000 papers per hour.

This same instrument can be arranged for power plant, factory, shop, locomotive and gas engine testing; in fact, speed testing of any kind. Can be furnished with any range scale from 0 to 10,000 R. P. M.

Full particulars and prices will be promptly furnished on application.

ELECTRIC SPEEDOMETER COMPANY, Washington, D. C.

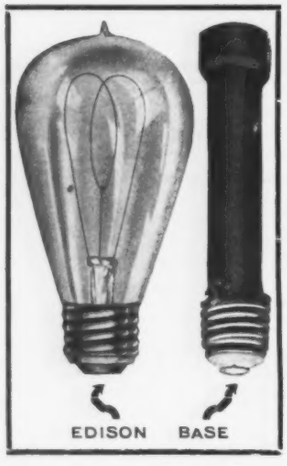
New York Branch, 1999 Broadway

WARD LEONARD

Why Use Lamps For Resistance?

when you can get much better results with

Ward Leonard Resistance Units



They are made to fit in lamp sockets and have a zero temperature coefficient resistance.

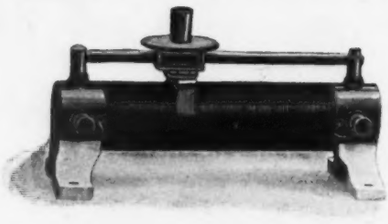
Made in any resistance up to 2,000 ohms—one layer of wire in a single unit—in 50-watt, 100-watt and 200-watt capacities.

Resistance wire is fully protected from mechanical, chemical and electrical depreciation by a coating of enamel.

Write for prices and discounts.

WARD LEONARD ELECTRIC CO.
BRONXVILLE, N. Y.

"G. R." Rheostats



From Germany we are importing a great variety of Adjustable Laboratory Rheostats—one type of which is illustrated above.

An oxidized resistance wire is wound on an enameled metal tube; the latter being of small weight, of ample strength and of rapid heat-dissipating qualities.

We have supplied G-R Rheostats to universities, colleges and technical schools throughout the country, and recommend them as well suited for use in *industrial laboratories.*

They were first brought to our attention by the Bureau of Standards several years ago.

For full particulars see Bulletin 721.

JAMES G. BIDDLE
1211-13 Arch St., PHILADELPHIA

Our new exhibition room is worth visiting.

YOUR Inductive Loads Can be Accurately Metered

By Using

Sangamo Type H Induction Meters

On Both

Single and Polyphase Distributing Systems

Write or Telegraph For Our New Proposition

Sangamo Electric Co.
Springfield, Ill.

Chicago Office:
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The Machine That "Excels All Others

in Economy, Efficiency and Durability" is in a big class.

It lacks distinction.

If your product has distinctive features, tell the readers of the Electrical World about them. They are interested.

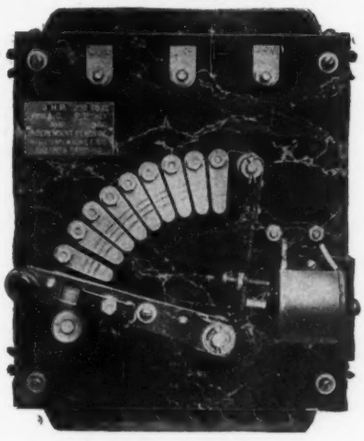
Electrical World
239 West 39th Street, New York

Independent Motor Starter

With No Voltage Release for Alternating Current.

Operated on all voltages, 60 to 133 cycles.

Asbestos tubes wound with special resistance wire, arranged to eliminate the effect of induction.



All parts renewable at small cost.

1911 catalog contains full and interesting details.

Independent Electric Mfg. Co.

Main Office and Works: 297-299 E. Third St.

MILWAUKEE, WIS.

The Sundh

Tank and Sump Switch

is rugged in construction and reliable in operation. It has a snap action which unfailingly gives quick break. It is weather proof

When double-acting it forms the most reliable high or low water alarm on the market. Write for catalog and prices.

SUNDH

Electric Company

115 CEDAR STREET

NEW YORK, U. S. A.

The deaf can hear by using this scientifically built transmitting and receiving device. The principle of the telephone as we alone know how to perfect it, is the basis of the

HEAR-A-PHONE

Price $20.00 Complete.

The No. 1 Hear-A-Phone is the lightest weight, smallest size and non-breakable. Improved direct current receiver and durable batteries.

So much depends upon the quality in each part of this sensitive telephone that we make everything in our own factory.

Write for Booklet No. 255 To-day.

STROMBERG-CARLSON TEL.MFG.CO

ROCHESTER, NEW YORK, U.S.A.

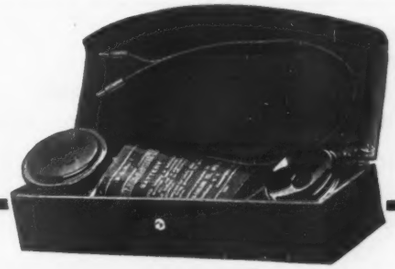
CHICAGO, ILL. KANSAS CITY, MO.

Toronto, Canada

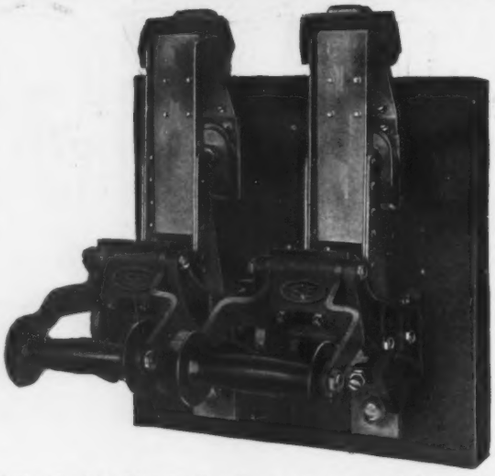
Pacific Coast Agency

Telephone-Electric Equipment Company

Seattle, Wash. San Francisco, Cal. Los Angeles, Cal.



Roller-Smith
CIRCUIT BREAKERS



Roller-Smith Circuit Breakers are unexcelled for their quickness of break, the small number of joints and contact surfaces employed, and the entire absence of catches or triggers. The powerful operating forces insure positive action every time. All breakers can be operated from the handle like a switch. Protection that PROTECTS.

MACHADO & ROLLER

203 Broadway, New York, General Sales Agents

1528 Oliver Building, Pittsburgh, Pa.
740 Monadnock Block, Chicago, Ill.
579 Howard St., San Francisco, Cal.
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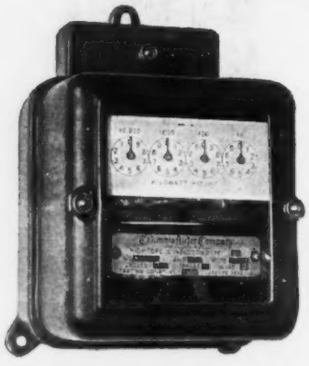
807 Brown Marx Building, Birmingham, Ala.

Columbia High Torque High Efficiency Induction Meter



Simple, well designed and well built. Accessible and highly accurate. Fully compensated.

Furnished with either circular dial or cyclometer registers. We invite opportunities for submitting specimens for test.

Columbia Meter Co. Canal and Tenth Streets
INDIANAPOLIS, INDIANA

MACHADO & ROLLER
Sales Agents
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VULCAN TOOLS

— ECONOMY —

Vulcan Electric Soldering Tools Will Do the Work of Two Old Style Soldering Coppers.

– WE CAN PROVE IT –

Every VULCAN Tool put in use sells another.

VULCAN Tools are Guaranteed

Write for particulars before turning page.

Vulcan Electric Heating Co.

ENGINEERS MANUFACTURERS DESIGNERS
1110 Military Road — TRADE VULCAN MARK — Buffalo N. Y.

PERFEX
The Perfect Cleaner

A machine that *does the work* and one you can recommend.
Takes the load off your customers' backs and puts it on the station.

The Portable PERFEX

weighs but 50 pounds. It employs a rotary frictionless pump driven by a 1-6 H.P. motor.

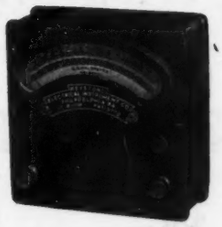
Quiet in operation.
Efficient in results.
Reasonable in price.

With top and sides removed the motor may be applied for operating all sorts of household appliances.
Ask for our special discount offer to Central Stations and Supply Dealers.
Write to-day

Perfex Cleaner Co.,
Waukegan, Ill.

KEYSTONE QUALITY

SUBSTANTIAL QUALITY



This Portable Voltmeter for direct currents can be had in almost any range—from 0-1 volt in 1/100 volt divisions up to 0-750 volts, in 5 volt divisions with single, double or triple scale. They can be had reading from zero at left or reading both ways from a central zero. Every indication can be fully dep nded upon. The most accurate portable instrument procurable anywhere at any price. Send for catalog 14.

Keystone Electrical Instrument Company

9th St. and Montgomery Ave., Philadelphia

NEW YORK	BOSTON	PITTSBURG
Hudson Terminal Building	170 Summer Street	Westinghouse Building

Eight Days At A Clip Without Rewinding!

Reliance mechanism consists of a well built, strong movement, with the motor side directly connected to a snap switch. The Reliance will operate consistently for eight days without rewinding.

The Reliance Automatic Time Switch

gives absolute control of lighting or power circuits, turning the current on and off at any predetermined hour. Is a sure and unfailing guard against waste of current. It saves money and increases efficiency.

The time to install the Reliance along your circuit is **now** and the means is the mailing of your name on a postal to us. **Send it!** 2

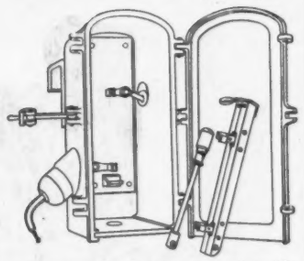
Reliance Automatic Lighting Company

Factory: Racine, Wisconsin Offices: Warren, Ohio

MATTHEWS FUSE SWITCH

Patent No. 986034

Ready to hook over cross-arm.



Showing detail of parts and inside.

Recurrent Surging Eliminated

The Matthews Fuse Switch combines the desirable function of both primary fuse and primary switch, serving as a fuse which operates positively without possibility of danger or injury to the men or line equipment, and can be cheaply and safely replaced when blown.

The fuse is of the standard expulsion type, discharging its gases positively and breaking the arc and so eliminating the damage and danger of recurrent surges experienced with fuse blocks.

As the fuse element is of plain fuse wire a few spools of different sized wire will enable the lineman to change the rating of any Matthews Fuse Switch without recourse to the complete assortment of high voltage inclosed fuses otherwise required.

Matthews Fuse Switch is designed to interrupt voltages from 1100 up to 6600 and has a maximum capacity of 75 amperes. Higher voltages and amperages can be taken care of on special orders.

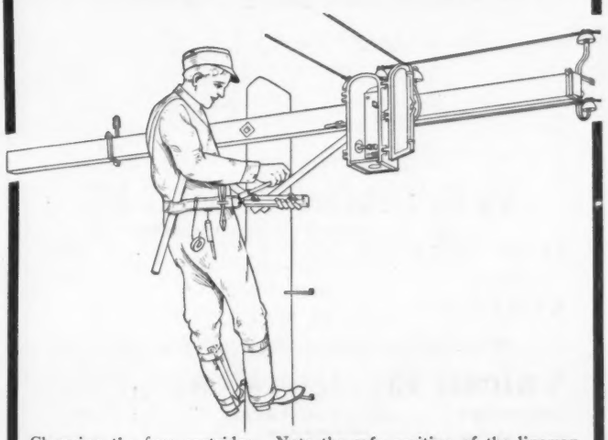
Write to-day for further information.

W. N. MATTHEWS AND BROTHER

Manufacturers of the following Patented Money Savers

Matthews Polerector, Matthews Guy Anchors, Matthews 2-Bolt Guy Clamp, Matthews Cable Rollers, Matthews Cable Clips, Matthews Cable Clamp, Matthews Holdfast Lamp Guards, Matthews Easy Lamp Changes, Etc.

227 NORTH SECOND STREET, ST. LOUIS, U. S. A.



Changing the fuse cartridge. Note the safe position of the lineman. He can't get hurt.

CUTLER-HAMMER

ELECTRIC HEATING DEVICES

It is not too late to begin a heating device campaign. The Cutler-Hammer Electric Iron provides comforts at all parts of the year—not only during the hot summer.

Should Be In Every Household

The Cutler-Hammer Disc Stove is the handiest heating device for the household. It can be used for warming baby's milk (at any time of day or night) for making fudges, desserts, toasts and for performing any of the simpler culinary operations. It can be connected to any lamp socket. Order these devices now. We will send you attractive literature bearing your imprint if desired.

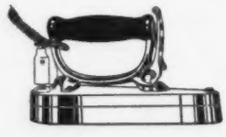
Cutler-Hammer Irons lesson the work—no lifting of the iron to a stand is required. When not in use the iron is supported by a patented back stand.

For baby dresses, sleeves, fancy waists, etc., the 3-lb. sleeve iron is especially useful. It has a long narrow body.

Because of its light weight and detachable handle it is also convenient to carry along when traveling.

Send for our 32-page booklet and make up a trial order of our various heating devices. Copy of the booklet sent promptly on request.

Household Iron. Made in three sizes, 5, 6 and 7 lbs. Requires no separate stand.



3-lb. Sleeve Iron, also convenient for travelers.

THE CUTLER-HAMMER MFG. CO., Milwaukee

District Office Addresses:

NEW YORK, Hudson Terminal (50 Church St.)
CHICAGO, Peoples Gas Building.
BOSTON, 176 Federal St.
PHILADELPHIA, 1201 Chestnut St.
PITTSBURG, Farmers' Bank Bldg.
CLEVELAND, Schofield Bldg.
PACIFIC COAST AGENTS, Otis & Squires, 579 Howard St., San Francisco and W. B. Palmer, 416 East 3rd St., Los Angeles.

DELCO COMBINATION SET

Consumes 500 Watts

Single Heat - - $20.00
Three Heat - - 23.00

Nickel or Copper Finish

25% DISCOUNT TO DEALERS AND CENTRAL STATIONS

Write for Booklet

Diamond Electric Co.

BINGHAMTON, N. Y.

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Two Things make a Technical Publication Valuable

(1) A live record of what is being thought and said and done in its field.

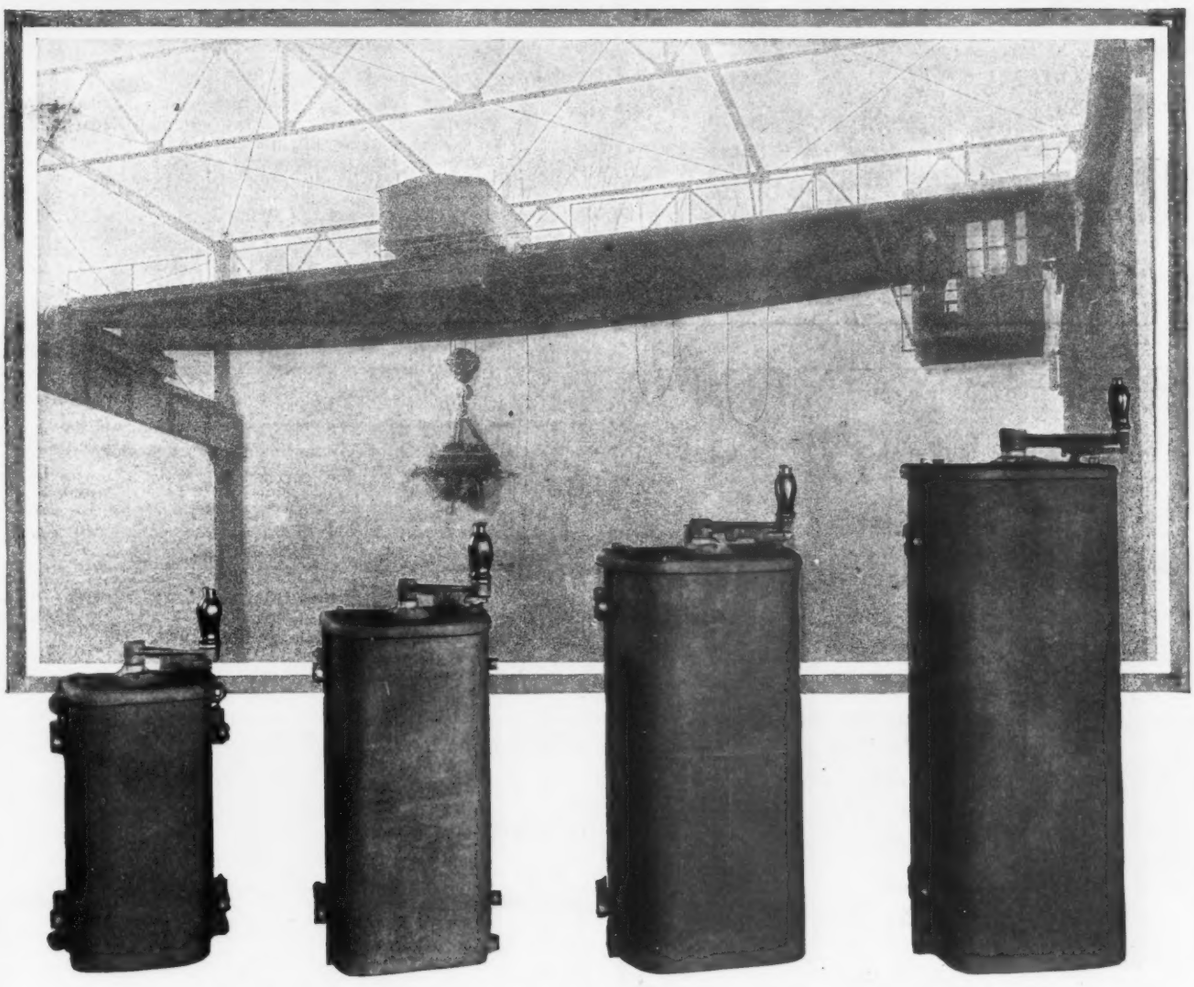
(2) Information as to what the market offers in supplies, equipment, and services.

¶ The first you get in the reading pages.
¶ The second you can find in the advertising pages.

Read Both

Electrical World, 239 West 39th St., New York

CUTLER-HAMMER



New Drum Controllers

For all types of cranes, steel-mill and hoisting machinery

Full Reversing and Dynamic Lowering Controllers are made. With the latter type in many cases the speed of descending load can be reduced to an almost imperceptible movement.

Ease of Operation

The operator can distinctly feel all points of control. A milled star wheel and substantial lever makes the rotary movement very easy.

Accessible Arrangements

Hinged pole piece allows easy access to fingers and segments. Entire finger-board can be taken out without removing the cylinder. The reversing segments with their respective fingers, which receive the greatest electrical and mchanical wear, are located at the top. Besides being more accessible, this arrangement also prevents the copper dust and dirt from falling on these segments and fingers, which would result if they were placed below.

New Non-Stubbing Fingers

These fingers make a straight line contact with the segment. They are pivoted at one end and held in contact by a steel spiral compression spring.

A description of this new line of controllers will interest you. New bulletins have just been published. Our nearest office will mail you a copy on request.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: Hudson Terminal (50 Church Street) CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Building
BOSTON: 176 Federal Street PHILADELPHIA: 1201 Chestnut St. CLEVELAND: Schofield Building
PACIFIC COAST AGENTS: Otis & Squires, 155 New Montgomery Street, SAN FRANCISCO
AGENT FOR SOUTHERN CALIFORNIA: W. B. Palmer, 416 E. 3rd St., LOS ANGELES

SIMPLEX IRONS 1911 MODELS

As Usual—Steady Improvement

Selling as Well as Earning Power Increased. Let us tell you how, or, write or wire now for a sample with detachable or permanently connected cord—we'll send prepaid and you can investigate.

Have you had our new Catalog No. 17W?

Simplex Electric Heating Co.
Cambridge, Mass.

Monadnock Block, CHICAGO. 612 Howard St., SAN FRANCISCO

HOSKINS

TRADE MARK REGISTERED

PRODUCTS

"Electricity to heat"

Electric Furnaces—*three distinct types*

For hardening of steel tools and parts, melting precious metals, baking enamel, cementing lenses, making chemical combustions,—indeed *for the better performance of scores of industrial operations*

Electric Hot-Plates

For laboratory work of all classes.

Electric Soldering Irons

The first to demonstrate the superior value of the one-piece copper.

***The Cheerie* TOASTOVE**

"The most attractive domestic heating appliance in the whole electrical field."

On Nickel-Chromium as a resistance element, our pioneering work and discoveries have been awarded the protection of basic patents (both American and foreign).

HOSKINS MANUFACTURING COMPANY
Electric—Furnaces, Pyrometers and Heating Appliances
467 Lawton Avenue, DETROIT.

311

A Live One

For Dealers

SHALER ELECTRO-PAD

Here is an article that appeals to the mother of the home—the readiest buyer in the country. The appeal is direct to her comfort and the comfort of her family. There is need for a Shaler Electro-Pad in every home equipped with electric lights. Its field is not limited to any one class as is that of the electric iron, which is of use only to those who do their own laundry work.

Let us tell you how the Electro-Pad relieves tooth ache, head ache, indigestion, neuralgia, sciatica, croup, lumbago and a number of other ailments.

Write us to show you how we help you sell Electro-Pads.

C. A. SHALER CO.
44 Fifth Ave., Waupun, Wis., U. S. A.

A COOL PROFIT

on first cost and one steady sure-fire, self-sustaining daily income that foots up to dollars—both results of the sale of one

HUGHES ELECTRIC COOKSTOVE

Wherever there's a family there's a call for the Hughes. This hot weather makes it doubly easy to sell—womenfolk don't want to spend the afternoon in a hot kitchen—or solve puzzles instead of cooking the dinner. The Hughes is simple. The heating units are guaranteed for one year and any one can replace them. The Hughes costs no more than an ordinary gas or gasoline stove. Uses little current but uses it day after day, morning, noon and night. That means a day load that ***counts.*** Get our literature, plan of cooperation and other details. ***Write to-day.***

HUGHES ELECTRIC HEATING CO.
226-228 W. Superior St., CHICAGO, ILLINOIS

Eastern Sales Agents: GEORGE DRAKE SMITH CO., 1161 Broadway, New York.
Denver, 961 Gas and Electric Bldg. Los Angeles, 419 South Grand Ave.
Minneapolis, 311 Second Ave., S. Seattle, Exchange Bldg.

WHY THE

Cadillac Combination Stove and Toaster is the most salable household electric device now on the market.

It cooks and toasts at the same time, is easy to regulate to three degrees of steady heat. Wellconstructed, handsomely finished in nickel and black enamel and absolutely clean in the using—it is bound to appeal to every user of electricity. It sells complete with cord for $7.50. A money maker or you because a money saver in the home

A beautifu new poster in our colors is now ready for dealers Also some mighty fine circu ars that are real helps.

Let us tell you more about it

CADILLAC ELECTRIC MFG. CO., 416 Mitchell St., Cadillac, Mich.

Red Head
TRADE MARK

RED HEAD Spark Plugs
Make Money for Electrical Supply Dealers

RED HEADS are the most popular spark plugs on the market. If you carry RED HEADS in stock you are sure to also gain new customers. RED HEADS are easier to handle than electrical supplies and are just as staple. The profits are equally as great.

Hundreds of electrical supply dealers are pushing their sale. When will you do it? Write for trade prices.

EMIL GROSSMAN CO., Mfr., 250 W. 54th St., New York
Branches: 1438 Michigan Ave., Chicago; 874 Woodward Ave., Detroit

The "Dostal Drop Out"

protects telephone or other circuits beneath your transmission line.
It clears the line and maintains service between the station and point of break.
Prices and full details yours for the asking.
Write.

The Western Engineering Specialties Co.
1732 Glenarm St. Denver, Colo.

The WAAGE The HANDIEST LITTLE ELECTRIC STOVE ON THE MARKET

Just the thing for the dining table, office or sick room, complete, with 6-foot cord. $3.50.

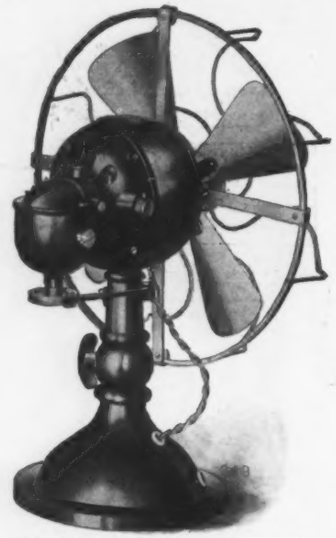
WAAGE ELECTRIC CO.
674 W. Madison St.
Chicago

Accurate, Compact, Inexpensive
VOLTMETERS, AMMETERS
and VOLT-AMMETERS
Send for complete catalog.
LOUIS M. PIGNOLET
78 Cortlandt Street New York

FOR AUTOMATIC MOTOR STARTERS, LIFTING MAGNETS, CONTROLLERS, ETC.
CONSULT
THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, O.

Diehl
TRADE MARK

ELECTRIC FANS



No 236—D. C. Oscillator Fan—Desk

All Types
Alternating and
Direct Currents

Described in Bulletin 24

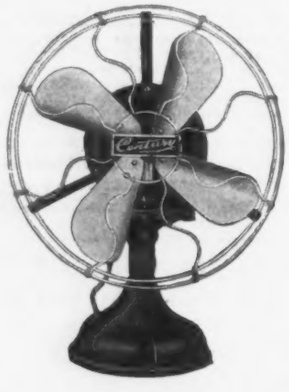
DIEHL MANUFACTURING COMPANY
ELIZABETHPORT, NEW JERSEY

BRANCHES:—New York, Chicago, Philadelphia, Boston
Williamsport, Pa., J. F. Rodgers, Frick Annex Bldg., Pittsburgh

Century

ALTERNATING CURRENT FANS

are efficient, move a larger volume of air, are quiet in operation, convertible to wall bracket fans without extra parts.



Have connections to compensate for low voltages, a 5-point speed switch, the design and construction is substantial and unique in many ways.

Bulletin No. 15 Describes Them.

Manufactured by the Single Phase Specialists

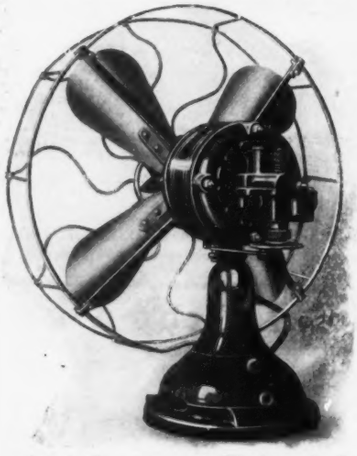
CENTURY ELECTRIC CO.

NEW YORK OFFICE
HUDSON TERMINAL
30 Church St.

MAIN OFFICE & WKS.
19th & OLIVE STS.
ST. LOUIS, MO.

Central Stations Recommend This Fan

Our complete line of Fans for all purposes is recognized the world over as "Standard"



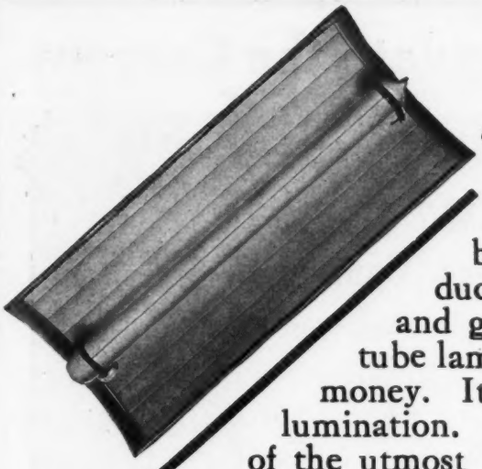
Light and Power Corporations everywhere have placed their stamp of approval on Robbins & Myers STANDARD fans because of their high quality and reliability. Our fans are known wherever Electric Fans are used. Our complete line includes ceiling, desk, bracket, oscillating and exhaust — for either direct or alternating current. We have built up this great reputation through 15 years of honest manufacture and are now backing it with the largest advertising compaign ever attempted with a similar line of electrical goods.

Write for Dealers' Contract

The Robbins & Myers Co.

Factory and General Offices **SPRINGFIELD, OHIO**

Branches: New York Chicago Boston Philadelphia St Louis Cleveland Atlanta Rochester New Orleans



Tube Lamps

This Type of Incandescent Lamp

adapts itself to a great variety of uses. It burns longer, gives greater efficiency, reduces cost of renewals, withstands vibration and gives true color value. The S. F. L. Co.'s tube lamp gives the consumer more light for less money. It is the most advanced form of modern illumination. If you use electric light in any form, it is of the utmost importance for you to learn about S. F. L. Co.'s Tube Lamps.

To the Trade

We have a proposition to offer you which enables you to secure new business and satisfy your present customers. Furthermore we have a special display window fixture which will secure large lighting contracts for your firm.

Write for particulars.

Straight Filament Lamp Company

149 BROADWAY, NEW YORK

Tungsten Lighting

10510½

Need not mean plain unornamental globes. There are many beautiful globes in the various sizes for your use. Globes that will soften and refine the light. Globes that will complete a definite decoration scheme. Globes that will give splendid illumination. Use the best globes in your work—"Phoenix Quality"—as they cost no more than the others and you will gain more by their use. Try them.

10476½-2

The Phoenix Glass Co.

Chicago New York Pittsburg

Emerson 3-Speed Induction Fans

The 8-inch and 12-inch Residence Types.

Fans designed especially for home use. They have full swivel-trunnion feature and are convertible into bracket fans without extra parts.

Famous Emerson hardened steel shaft and oil-tight dust-proof bearings in these new models. Write for catalog.

The Emerson Electric Mfg. Co.
2032 Washington Ave., St. Louis, Mo.
50 Church St., New York City

ELECTRIC SEARCH LIGHTS

7-inch to 36-inch diameter for ocean, lake and river steamers and launches; also electric light plants driven by gasoline engine for isolated lighting.

The Carlisle & Finch Co.
228 E. Clifton Avenue
CINCINNATI, OHIO

"STAVE"

The Longest Life from the Shortest Flaming Arc Lamp

100 Hours per Trim or 150 Hours per Trim

Strong, sturdy carbons—globes always clean.

One pair of carbons only—No Magazine.

Total height of lamp is but 32" for 100-hour type.

Total height of lamp is but 37" for 150-hour type.

Positive, steady feed produces unflickering white or yellow light.

2,200 Candle Power with White Carbons.
3,000 Candle Power with Yellow Carbons.
550 watts.

Burns on 10 amp. constant potential and constant current circuits.

The Lamp for City Lighting, Factory Lighting, Any Lighting

Stave Electrical Company

Main Office: 131 Hudson St., New York

Branches in all principal cities

Regulate the Current

Designed especially for Mazda Series lamp control.

"A-W" Mazda Series Control

High Efficiency. High Power Factor.

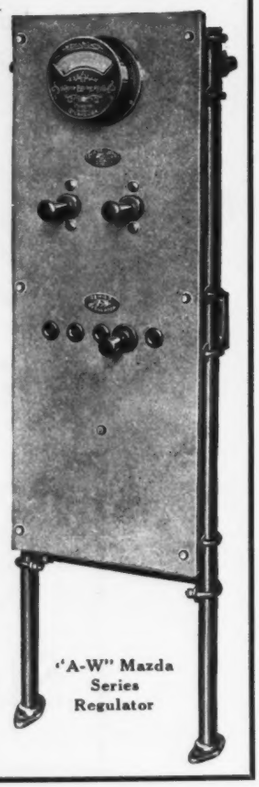
No Moving Parts.

Fully Guaranteed.

Simple — inexpensive — dependable.

Just install one. The regulator will do the rest.

Write us for points on series lighting.



"A-W" Mazda Series Regulator

Sold by

Electric Appliance Co.
Chicago Dallas
San Francisco New Orleans

The Wesco Supply Co.
St. Louis
Fort Worth Birmingham

The Packard Electric Co.
500 Dana Ave., Warren, Ohio

No. 4038 Luceo.

For 100 and 150-watt Lamp Fitter, 2½"; height, 4½"; diameter, 11¼". 1½ doz. in barrel.

LUCEO

Shades and Reflectors

give maximum diffusion and reflection. They are scientific, decorative and effective. Write for prices.

New York Office and Sample Room, 32 Park Place

The Jefferson Glass Company

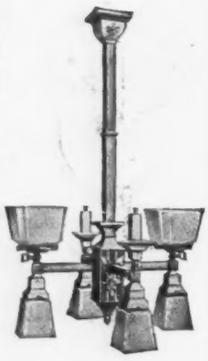
Follansbee, West Virginia

Our New "Highland" Line of Electric, Gas and Combination Fixtures

The same methods as used in the manufacture of our portables will be adopted in these fixtures and when shipped they will be mechanically correct, plumb and square.

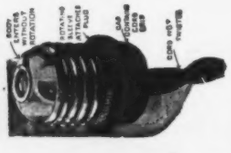
These fixtures are winners and prices low. Line includes fixtures of all kinds, Tungsten fixtures, showers and brackets.

Write for Illustrations and mention "Highland" Line



The Goodwin & Kintz Co.

Station C, Winsted, Conn.



BENJAMIN'S

IN-IM-I-TA-BLE 9-0-3

Write for Quantity Discounts on Your 1911 Requirements

BENJAMIN ELECTRIC MFG. CO.

New York Chicago San Francisco

The Moore Light

"Comes in Long Vacuum Tubes."

Yellow Light The Best Illumination for Large Areas.

White Light A Duplication of Daylight. The Only Light for Color Matching.

The Moore Light Window is factory-built. Send for description.

Moore Light Co., Newark N. J.

Mr. Carnegie's Success

was largely due to his ability to surround himself with men of ideas. They supplemented and stimulated his own. He says so himself. The same is true of most other successful men.

Every issue of the Electrical World is full of the ideas of other men in your field. You will find them in the reading pages and in the advertisements as well. For your own interest, familiarize yourself with what the market offers.

Make it a point to look through the advertisements. They are loaded with suggestions which lead to economies and increased profits. A short note to any manufacturer referring to his advertisement brings you his story. Look through the advertising pages in this issue.

Electrical World
239 West 39th St. - - New York

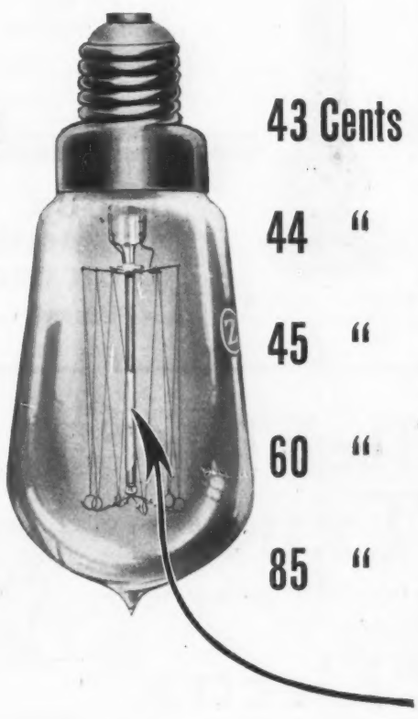
"Z" TUNGSTEN LAMPS

A Reliable Product
Not An Experiment

Hundreds of Keen, Shrewd Buyers are Purchasing "Z" Lamps, WHY NOT YOU?

Send Us Now Your Order for a Standard Package at the following prices, in standard packages, f. o. b., New York.

18-Watt			43 Cents
25	"		44 "
40	"		45 "
60	"		60 "
100	"		85 "



THE USE OF **PHOSPHAME**

Covered by our valuable BASIC PATENT, insures LONG LIFE and NON-BLACKENING

American "Z" Electric Lamp Company

Singer Tower, 149 Broadway, N. Y.

Pacific Coast Representative
CHAS. L. KIEWERT & COMPANY
19 Sutter St. San Francisco, Cal.

Corinthian Standard
Patented 39759

REASONS WHY

EXPERIENCE

Experience is the greatest teacher.

The careful, conscientious, persistent strife—for improvement—is always rewarded by actual improvement.

We have 35 years of this continued tenacity of purpose.

Critics tell us it is evident in the Corinthian Standard.

NOW YOU KNOW!

Two

FLOUR CITY ORNAMENTAL IRON WORKS

Minneapolis, Minn.

Opalux Reflectors

FOR MODERN ILLUMINATION

"The Glass Without the Glare"

OPALUX is a scientific reflector providing the greatest volume of soft, uniform light because its diffusion is from the reflecting side. The attractive, smooth, milk-white, shell-like surface is not affected by dust, as the reflection is entirely from the inner, or first surface. Dust settling upon the outer surface has no effect upon the efficiency, while both surfaces are easily cleaned, owing to the absence of deep dust catching grooves.

It has every attribute necessary in an ideal reflector, artistic appearance, mechanical stability, ease of cleaning as well as a minimum limit of cost.

In "OPALUX REFLECTORS" science and art have been combined to produce an ideal system of diffusion for high efficiency lamps, assuring a maximum of radiance at a minimum cost for current.

Descriptive Catalogue and Prices Upon Request

Both will be found interesting

The Opalux Company

258 Broadway, New York

Eastern Distributers: Pettingell-Andrews Co., Boston, Mass.
Western Distributers: Central Electric Co., Chicago, Ill.
For Canada: Canadian General Electric Co., Ltd., Toronto, Can.

The Whole Truth

about the carbon question is that

"Electra" Carbons

are most economical for you to use because they give the most light and the steadiest light. Their use involves least trimming and cleaning cost, too.

Big stock for immediate delivery.

Samples at your word.

Hugo Reisinger

Sole Importer of "Electra" Carbons

11 Broadway, New York 3

For Big Spaces Indoors

—shops, foundries and the like — no illuminant excels the Excello.

125-Hour "H. M. H." Flaming Arc

It gives a brilliant yellow light at low carbon cost on 10-12 amp. Burns 2 in series on 110 volts, 4 in series on 220 volts.

The novel Excello guarantee protects you for two years.

Will you have details?

THE EXCELLO ARC LAMP COMPANY

H. M. Hirschberg, President. 30-32 E. 20th St., New York.

CHICAGO: 631 West Boulevard
BOSTON: 184 Franklin Street
CLEVELAND: 337 Superior Avenue, West
PHILADELPHIA: Keith's Building

Night Scene, Broughton Street, Savannah, Ga.

Design No. 1005.

Union Lamp Standards Cannot Be Broken

The only cast iron in their construction is in the base and cap—the shaft is made by a patented process which represents the latest development in the ornamental lighting field.

Base and top can be furnished in cast bronze, with the shaft veneered with sheet copper, brass or bronze.

Besides being safer to pedestrians and more durable than cast iron standards, Union Lamp Standards are much lower in cost. They are designed in strict accordance with the classical orders of architecture, and will ornament the streets of any city.

Write for detailed information and list of 65 cities where installations have been made.

The Union Metal Manufacturing Company

CANTON Sole Manufacturers **OHIO**

Tungsten Sign Lamp
5 watts
10 to 13 volts
List 40c
Guaranteed Life
2,000 hours

Hygrade

Not the Label but what the Label stands for

HYGRADE

Send for our Independent Proposition for a lamp equal to any Association lamp at a Lower Price

Hygrade Incandescent Lamp Co.

136 Liberty Street, New York — Factory, Danvers, Mass.

Philadelphia, St. Louis, Chicago, Pittsburgh, Seattle

A New Device

It automatically turns out an incandescent electric light when forgotten.

The cut-off is attached to a regulation socket and turns the key after a predetermined time has elapsed. Adjustable from one minute to three hours.

Once set, nothing more to do but turn on the light.

Just what is needed in the Cellar, Toilet Room, Stock Room, etc.

Complete, post paid, Price, $2.50.
Special Discount to Dealers.

PAUL DIXON,
19 Willow Street, Atlanta, Ga.

TUNGSTEN LAMPS

5-Watt, 10-Volt
12-Watt, 22-Volt
20-Watt, 22-Volt
25-Watt, 22-Volt

LOWVOLT

30c each
To the Trade
Vacuum Glass Co., Lynn, Mass.

The Stacks and Art Galleries

OF THE

New York Public Library

ARE LIGHTED BY

Frink Reflectors

St. Louis Mo. Cleveland, O. **I. P. FRINK** San Francisco, Cal. Portland, Oregon

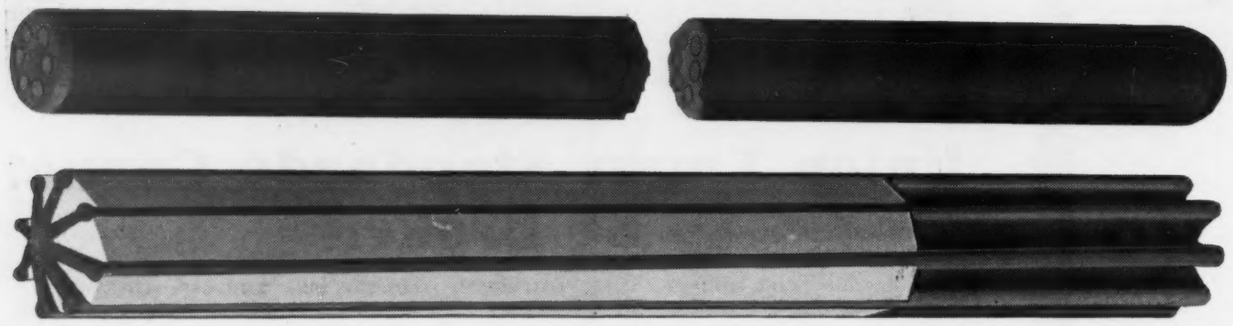
24th St. & 10th Ave.
NEW YORK

UNION ELECTRIC CO Pittsburg Terminal Warehouses PITTSBURG PA.

Everything Electrical

COLUMBIA REGENERATIVE CARBON

A SPECIALLY MADE, LONG LIFE CARBON FOR REGENERATIVE FLAMING LAMPS



Here is a chance to get satisfaction.

Columbia Regenerative Flaming Carbon has made good in practically every form of commercial and industrial installations of the regenerative flaming lamp.

It will make good in your lamp wherever it is installed.

It will avoid the outages and their annoyances caused by carbons slagging. It does not slag.

Then, too, there is the life of the carbon to be considered.

The life of Columbia Regenerative Flaming Carbon is considerably longer than the maximum requirements of the lamp.

This is a very valuable point to consider, for it means a reduction in cost of maintenance without affecting the burning quality.

Every carbon is individually inspected for straightness, roundness, uniformity of length and diameter, and then wrapped in paraffine paper.

We guarantee each pair.

NATIONAL CARBON COMPANY - CLEVELAND, OHIO

GILLINDER Illuminating GLASSWARE

Cut White Etched
Roughed Bright Etched
Opal Alabaster
Prismatic Reflectors

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Rotary Flush Switch

"Diamond H"

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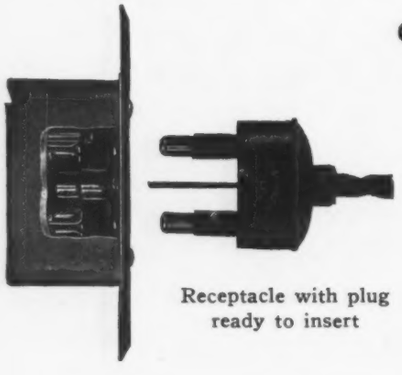

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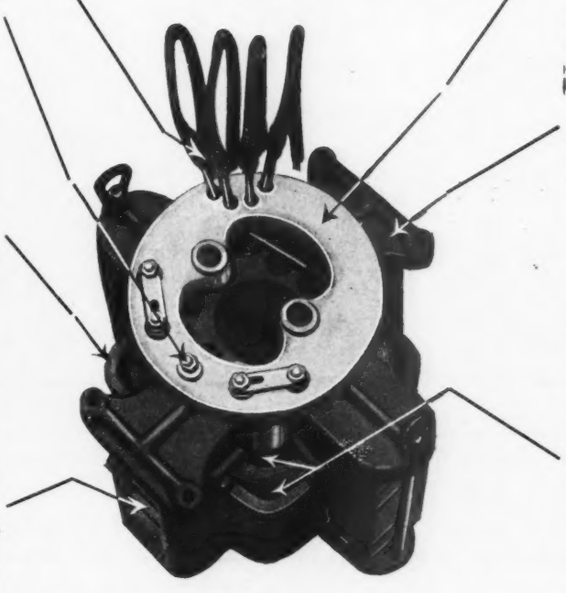
1. **The leads** are rigidly and securely supported by the connection board—and do not cross each other.

2. **Blind terminal connection** makes accidental short circuits during change of connections impossible.

3. **The coils**—are thin, giving rapid heat radiation.
—are cylindrical, eliminating sharp turns which weaken the insulation.
—are treated with a moisture repelling compound which increases the rigidity, prevents creeping of turns and assists in conducting the heat.

4. **The interlocked core** is strong, compact and symmetrical, insuring balanced magnetic conditions, uniform heating and effective radiation.



Type H Transformer Core and Coils

5. **The submerged connection board** places all live parts under oil and reduces to a minimum all risk from static or lightning discharge.

6. **The transformer** is permanently held in place by top and bottom core clamps. The top clamp is securely bolted to lugs in the case. The bottom clamp spans a boss in the bottom of the tank. Consequently the Type H Transformer stays in place through years of severe service.

7. **Large oil ducts** between the coils and between the windings and the core, provide for continuous circulation of oil. These spaces together with the symmetrical design of the core, effect uniform heating throughout, and make hot spots unknown in the Type H.

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The Weber Electric Company hereby notifies the trade that following its established policy of protecting its patent rights, it has brought suit in the United States Circuit Court for the Northern District of New York, against Frank E. Greis, trading under the name and style, Syracuse Gas & Electric Fixture Company, for the sale of Yost Incandescent Electric Lamp Sockets.

The Weber Electric Company now has suits for infringement pending against parties dealing in Yost, Union, Wirt and Freeman sockets, which suits are being vigorously prosecuted.

Said suits have been brought by the Weber Electric Company upon the advice of eminent counsel and experts that the several types of sockets named infringe upon the Weber patents. Dealers handling any of said sockets which shall be decreed by the Court to infringe upon said Weber patents will be held to strict account for such infringement.

The Weber patents involved in the suits above referred to are No. 743,206 and No. 743,207, each dated November 3, 1903, and No. 916,812, dated March 30, 1909.

Henry D. Sears, 131 State St., Boston, Mass.
General Sales Agent, Weber Electric Company 1

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N. E. C. SPECIFICATIONS
STANDARD UNDERGROUND CABLE CO.
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For Finishing Purposes Use
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Doubleday-Hill Elec. Co.
Heany Fireproof Wire Co.
Union Elec. Co.
Western Elec. Co.

Coils, Induction.
Ostrander & Co., W. R.
Splitdorf, C. F.
Western Electric Co.

Coils, Spark.
Grossman & Co., Mfr., Emil.
Splitdorf, C. F.
Western Electric Co.

Coloring, Lamp.
McGill Mfg. Co.

Commutators.
Doubleday-Hill Elec. Co.

Commutator Segments.
Billings & Spencer Co.
Doubleday-Hill Elec. Co.
Union Elec. Co.

Commutators, Truing.
Jordan Bros.

Compounds, Boiler.
Dearborn Drug & Chem. Wks.

Compounds, Commutator.
McLellan Co., K.

Condensers.
Alberger Condenser Co.
Allis-Chalmers Co.
Westinghouse Machine Co.

Conduit Bends.
Fibre Conduit Co.

Conduit Fittings.
Sprague Electric Works.

Conduit Rods.
Cope, T. J.

Conduits, Interior.
Fibre Conduit Co.
Knowles, C. S.
National Metal Molding Co.
Sprague Electric Works.

Conduits, Underground.
American Conduit Mfg. Co.
American Sewer Pipe Co.
Camp Co., H. B.
Clermont Sewer Pipe Co.
Fibre Conduit Co.
Gest, G. M.
Johns-Manville Co., H. W.
Monolithic Conduit Co.
National Conduit & Cable Co.
Simplex Conduits, Ltd.
Wyckoff Pipe & Creosoting Co.

Controllers.
Allen-Bradley Co.
Allis-Chalmers Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Independent Electric Mfg. Co.
Monitor Controller Co.
Simplex Electric Heating Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery. (Coal, Ashes, etc.)
Green Eng'g. Co.
Link-Belt Co.
Morse Chain Co.

Cooling Towers.
Alberger Condenser Co.

Cord Adjusters.
Matthews & Bro., W. N.

Cord, Arc Lamp.
American Vul. Fibre Co.
Sampson Cordage Works.

Cord, Flexible.
American Electrical Works.
Belden Mfg. Co.
Sprague Electric Works.

Cord, Trolley.
Sampson Cordage Works.

Crane Motors.
Crocker-Wheeler Co.
Ideal Electric & Mfg. Co.
Sprague Electric Works.
Triumph Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
Maris Bros.

Cross-Arms.
Berlin Mills Co.
Western Electric Co.

Cut-Outs.
D. & W. Fuse Co.
Sears, Henry D.
Wyckoff Pipe & Creosoting Co.

Designers, Electric.
Esterline Co.
Sundh Electric Co.

Dials.
Manhattan Dial Co.

Dies.
Watson-Stillman Co.

Drills, Brick.
Barnes Co., W. F. & Jno.
Hubbard & Co.

Drills, Portable.
Stow Mfg. Co.

Drop Forgings.
Billings & Spencer Co.

Drying Machinery.
American Blower Co.
Buffalo Foundry & Mach. Co.

Dynamos, Motors.
Allis-Chalmers Co.
Burke Elec. Co.
Century Electric Co.
Crocker-Wheeler Co.
Doubleday-Hill Elec. Co.
Diehl Mfg. Co.
Eck Dynamo & Motor Co.
Electric Construction Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
Fort Wayne Electric Works.
Garwood Elec. Co.
General Electric Co.
Gregory Electric Co.
Ideal Electric & Mfg. Co.
Kimble Electric Co.
Lincoln Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng'g Co.
Richmond Electric Co.
Ridgway Dynamo & Eng. Co.
Robbins & Myers Co.
Roth Bros. & Co.
Sprague Electric Works.
Stow Mfg. Co.
Triumph Electric Co.
Wagner Elec. Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Electromagnets.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Grossman Co., Mfr., Emil.
Splitdorf, C. F.
Sundh Electric Co.

Elevators.
Link-Belt Co.

Engineers, Consulting.
(See Directory of Engineers.)

Engineers, Contracting.
(See Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Co.
Carlisle & Finch Co.
National Meter Co.
Turner-Fricke Mfg. Co.
Westinghouse Machine Co.

Engines, Steam.
Allis-Chalmers Co.
American Blower Co.
Ball Engine Co.
Ball & Wood Co.
McIntosh, Seymour & Co.
Murray Iron Works.
Ridgway Dynamo & Eng. Co.
Skinner Engine Co.
Westinghouse Machine Co.
York Mfg. Co.

Experimental Apparatus.
Doubleday-Hill Elec. Co.
Esterline Co.
Roller-Smith Co.
Union Electric Co.

Fan Motors.
Century Electric Co.
Diehl Mfg. Co.
Doubleday-Hill Elec. Co.
Eck Dynamo & Motor Co.
Emerson Electric Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Goldmark Co., James.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Electric Works.
Union Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fans. (Exhaust & Ventilating.)
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
Sprague Electric Works.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fibre. (See Insulating Material.)

Fibre Tubing.
American Vul. Fibre Co.
Fibre Conduit Co.
Parker & Sons Fibre Co., J. C.

Field Coil Pads.
Massachusetts Chemical Co.

Filters (Oil).
Elliott Co.

Financial.
Coal & Iron National Bank.
Electric Bond & Share Co

Fire Extinguishers.
Pyrene Mfg. Co.

Fixtures. (Gas and Electric.)
Benjamin Elec. Mfg. Co.
Central Electric Co.
Flour City Ornamental Iron Works.
Frink, I. P.
Goodwin & Kintz Co.

Flanges, Welded.
Ball & Wood Co.

CLASSIFIED INDEX—Continued.

Flashers.
Reynolds Elec. Flasher Mfg. Co.

Friction Tape and Cloths.
Johns-Manville Co., H. W.
Massachusetts Chemical Co.

Furnaces, Electric.
Hoskins Mfg. Co.

Fuses.
Chicago Fuse Mfg. Co.
Condit Elec. Mfg. Co.
D. & W. Fuse Co.
Detroit Fuse & Mfg. Co.
Johns-Manville Co., H. W.
Sears, Henry D.

Fuse Boxes, A. C. Oil.
Johns-Manville Co., H. W.

Gas Lighting Apparatus.
Ostrander & Co., W. R.
Splitdorf, C. F.

Gauges, Recording.
Bristol Co.
Industrial Instrument Co.

Gauges, Water Column.
Jenkins Bros.

Gears.
New Process Rawhide Co.

Generating Sets.
Allis-Chalmers Co.
Carlisle & Finch Co.
Ideal Electric & Mfg. Co.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Glass.
Gillinder & Sons, Inc.
Phoenix Glass Co.

Globes, Shades, Etc.
Gillinder & Sons, Inc.
Jefferson Glass Co.
Opalux Co.
Phoenix Glass Co.

Graphite.
Acheson Graphite Co. (International).
Dixon Crucible Co., Joseph.

Grates.
Green Eng'g. Co.

Grounds, Etc.
Paragon Sellers Co.

Guards, Inc. Lamp.
Frink, I. P.
Hubbell, Inc., Harvey.
Matthews & Bro., W. N.

Guy Clamps.
Matthews & Bro., W. N.

Hangers, Cable.
Condit Electrical Mfg. Co.
Standard Underground Cable Co.

Heaters, Feed Water.
Alberger Condenser Co.
Harrison Safety Boiler Wks.

Heating and Ventilating Apparatus.
American Blower Co.

Heating Devices, Electric.
Cadillac Electric Mfg. Co.
Cutler-Hammer Mfg. Co.
Diamond Electric Co.
General Electric Co.
Hoskins Mfg. Co.
Hughes Elec. Heating Co.
Shaler Co., C. A.
Simplex Electric Heating Co.
Vulcan Electric Heating Co.
Waage Electric Co.
Westinghouse Elec. & Mfg. Co.

Hoists, Electrical and Steam.
Allis-Chalmers Co.
Maris Bros.
Sprague Electric Works.
Yale & Towne Mfg. Co.

Hoists, Magnetic.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.

Hot Water Bottles, Electric.
Shaler Co., C. A.

House Cleaners, Vacuum.
Perfex Cleaner Co.

Hydraulic Machinery.
Allis-Chalmers Co.
Pelton Water Wheel Co.

Ice Machines.
Carbondale Machine Co.
York Mfg. Co.

Igniters, Gas Engine.
Carlisle & Finch Co.

Indicators.
Excess Indicator Co.

Indicators, Speed.
Roller-Smith Co.

Injectors.
Jenkins Bros.

Instruments, Electrical.
Graphic.
Bristol Co.
Esterline Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Indicating.
Eldredge Elec. & Mfg. Co.
General Electric Co.
Hoyt Elec'l Instr. Works.
Keystone Elec'l Instr. Co.
Pignolet, L. M.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Instr. Co.
Integrating.
Columbia Meter Co.
Duncan Elec. Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing.
J. G. Biddle.
Esterline Co.
Gurley, W. & L. E.
Leeds & Northrup Co.
Queen & Co., Inc.

Insulating Cement.
Massachusetts Chemical Co.

Insulating Machinery.
American Insulating Machinery Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Colonial Sign & Ins. Co.
General Bakelite Co.
Hartford Faience Co.
Hemming Mfg. Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Pittsburgh High Voltage Ins. Co.
Star Porcelain Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Electric Cable Co.
General Bakelite Co.
Hemming Mfg. Co.
Massachusetts Chemical Co.
Mica Insulator Co.
Mitchell-Rand Mfg. Co.
Standard Paint Co.
Standard Varnish Works.
Sterling Varnish Co.
Composition, Cloth and Paper.
Mica Insulator Co.
Massachusetts Chemical Co.
Fibre.
American Vul. Fibre Co.
Diamond State Fibre Co.
Parker & Sons Fibre Co., J. C.
Lava.
Steward Mfg. Co., D. M.
Silk.
Ryle & Co., Wm.
Staples.
Blake Signal & Mfg. Co.
Goldmark Co., James.
Tape.
American Electrical Works.
Massachusetts Chemical Co.
Mica Insulator Co.
New York Insulated Wire Co.
Standard Underground Cable Co.
Transmission.
Western Engineering Spec. Co.

Insulators, China, Porcelain and Composition.
Central Electric Co.
Clark Elec. & Mfg. Co., W. G.
Colonial Sign & Ins. Co.
General Electric Co.
Imperial Porcelain Works.
Johns-Manville Co., H. W.
Locke Insulator Mfg. Co.
Mica Insulator Co.
Pittsburgh High Voltage Ins. Co.
Sears, Henry D.
Star Porcelain Co.
Thomas & Sons Co., R.
Western Electric Co.

Insulators, Glass.
Brookfield Glass Co.
Hemingray Glass Co.
Locke Insulator Mfg. Co.

Insulators, Transmission.
Western Eng'g Specialties Co.

Jacks.
Watson-Stillman Co.

Joints, Expansion.
Alberger Condenser Co.

Lamp Changers or Replacers.
Matthews & Bro., W. N.

Lamps, Arc.
Excello Arc Lamp Co.
Fort Wayne Electric Works.
General Electric Co.
Queen & Co., Inc.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc.
Excello Arc Lamp Co.
Stave Electrical Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent.
American "Z" Elec. Lamp Co.
Central Electric Co.
General Electric Co.
Hygrade Incandescent Lamp Co.
Straight Filament Lamp Co.
Vacuum Glass Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Miniature.
General Electric Co.

Lamps, Vacuum Tube.
Moore Light Co.

Lathes.
Barnes Co., W. F. & Jno.

Lava. (See Insulating Material, Lava.)

Lighting Companies.
Commonwealth Edison Co.

Lightning Arresters.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Line Material.
Archbold-Brady Co.
Clark Elec. & Mfg. Co., W. G.
G. & W. Electric Co.
Johns-Manville Co., H. W.
Ohio Brass Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lubricants.
Acheson Graphite Co. (International.)
Dearborn Drug & Chemical Works.
Dixon Crucible Co., Jos.
Kellogg Co., E. H.

Lumber.
Wyckoff Pipe & Creosoting Co.

Machine Tools.
Garvin Machine Co.

Machinery, Grinding.
Geometric Tool Co.

Machinery, Special.
Watson-Stillman Co.

Magnet Wire.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D. & W. Fuse Co.
Heany Fireproof Wire Co.
Massachusetts Elec. & Mfg. Co.
Riegé, Archer C.
Standard Underground Cable Co.
Stromberg-Carlson Telephone Mfg. Co.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.
Heany Fireproof Wire Co.
Western Electric Co.

Mechanical Draft.
American Blower Co.

Mechanical Stokers.
Westinghouse Machine Co.

Medical Apparatus.
Manhattan Elec'l Supply Co.
Pignolet, Louis M.
Splitdorf, C. F.

Metals.
American Platinum Works.
Baker & Co., Inc.
Phosphor-Bronze Smelting Co.

Metal Polish.
Hoffman, Geo. W.

Meter Testers.
Electrical Meter Testing Co.
Marcuson, E.

Mica.
Jaroslaw, D.
Mica Insulator Co.

Mining Machinery.
Allis-Chalmers Co.
Crocker-Wheeler Co.
General Electric Co.

Model Makers.
Esterline Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Cincinnati Tool Co.

Novelties, Electric.
Carlisle & Finch Co.

Oil, Cylinder. (See Lubricants.)

Packing.
Jenkins Bros.
Johns-Manville Co., H. W.

Panel Boards.
Trumbull Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Phosphor Bronze.
Phosphor Bronze Smelting Co.

Photometer Standards.
Electrical Testing Laboratories.

Pinions, Rawhide.
New Process Rawhide Co.

Pipe and Boiler Coverings.
Johns-Manville Co., H. W.

Platinum.
American Platinum Works.
Baker & Co., Inc.
Roessler & Hasslacher Chemical Co.

Plugs.
Condit Electrical Mfg. Co.
Hubbell, Inc., Harvey.
Paiste Co., H. T.
Sears, Henry D.

Pole Line Hardware.
Hubbard & Co.

Poles.
Wyckoff Pipe & Creosoting Co.

Poles, Arc Lamp.
Flour City Ornamental Iron Works.
Morris Iron Co.
Union Metal Mfg. Co.
Western Electric Co.

Poles, Brackets, Pins, etc.
Berlin Mills Co.
Morris Iron Co.
Page & Hill Co.
Sand Point Lumber & Pole Co., Ltd.
Western Electric Co.
Western Lumber & Pole Co.

Poles, Reinforcing.
Pittsburg Reinforcing Pole Co.

Poles, Steel.
Franklin Steel Co.

Porcelain. (See Insulating Material, China and Porcelain.)

Potentiometers.
Biddle, J. G.
Leeds & Northrup Co.

Potheads.
Colonial Sign & Ins. Co.
G. & W. Electric Co.

Power Transmission Machinery.
Link Belt Co.
Morse Chain Co.

Presses.
Watson-Stillman Co.

Producers, Gas.
Westinghouse Machine Co.

Pulleys.
Rockwood Mfg. Co.

Pumps, Air.
Goulds Mfg. Co.

Pumps, Centrifugal.
Alberger Pump Co.
Allis-Chalmers Co.
De Laval Steam Turbine Co.

Pumps, Electric.
Blake & Knowles Steam Pump Wks.
De Laval Steam Tuprbine Co.
Goulds Mfg. Co.

CLASSIFIED INDEX—Continued.

Pumps, Oil.
Ludlow Valve Co.

Pumps, Steam.
Alberger Condenser Co.
Alberger Pump Co.
Allis-Chalmers Co.
Blake & Knowles Steam Pump Wks.
De Laval Steam Turbine Co.
Deming Co.

Pumps, Vacuum.
Alberger Condenser Co.
Goulds Mfg. Co.

Purifiers, Feed Water.
Harrison Safety Boiler Works.

Push Buttons.
Dunbar Bros. Co.
Manhattan Elec'l Supply Co.

Rail Bonds.
Clark Elec. & Mfg. Co., W. G.
Condit Electrical Mfg. Co.
Roebling's Sons Co., J. A.

Railways, Miniature.
Carlisle & Finch Co.

Receptacles. (See Sockets.)

Rectifiers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Reflectors.
Frink, I. P.
Goodwin & Kintz Co.
Jefferson Glass Co.
Opalux Co.

Refrigerating Machines.
Carbondale Machine Co.
York Mfg. Co.

Regulators (Feed Water).
Elliott Co.

Repairing.
Chicago Armature & Mot. Co.
Commonwealth Edison Co.
Gregory Electric Co.
Westinghouse Elec. & Mfg. Co.

Resistance Units.
Cutler-Hammer Mfg. Co.
Independent Electric Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Wirt Electric Specialty Co.

Resistance, Wire.
Belden Mfg. Co.
Driver-Harris Wire Co.

Rheostats.
Allen-Bradley Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Elect. Controller & Mfg. Co.
General Electric Co.
Independent Electric Mfg. Co.
Monitor Controller Co.
Simplex Electric Heating Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
Hart Mfg. Co.
Paiste Co., H. T.
Sears, Henry D.
Trumbull Electric Mfg. Co.

Sal Ammoniac.
Roessler & Hasslacher Chemical Co.

Schools & Colleges.
Wentworth Institute.

Searchlights.
Carlisle & Finch Co.

Second-Hand Apparatus.
Duzets & Sons.
Gregory Electric Co.
Jordan Bros.
MacGovern, Archer & Co.
Machinery Brokerage Co.
Partridge, Arthur S.

Separators. (Oil and Steam.)
Beggs & Co., James.
Elliott Co.
Harrison Safety Boiler Wks.

Shade Holders.
Hubbell, Inc., Harvey.

Shades.
Frink, I. P.
Gillinder & Sons, Inc.
Hubbell, Inc., Harvey.
Jefferson Glass Co.
Opalux Co.
Phoenix Glass Co.

Shafts, Flexible.
Stow Mfg. Co.

Sheet Metal.
American Sheet & Tin Plate Co.

Sheets, Electrical.
American Sheet & Tin Plate Co.
Follansbee Bros. Co.

Signs, Electric.
Colonial Sign & Ins. Co.
Frink, I. P.
Reynolds Elec. Flasher Mfg. Co.

Sign Letters.
Colonial Sign & Ins. Co.

Sleeving, Braided.
Belden Mfg. Co.

Sockets & Receptacles.
Benjamin Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
Freeman Electric Co., E. H.
General Electric Co.
Hubbell, Inc., Harvey.
Johns-Manville Co., H. W.
Paiste Co., H. T.
Sears, Henry D.

Sockets, Turn-Down.
Dixon, Paul.
Wirt Elec. Spec. Co.

Solder.
Belden Mfg. Co.

Soldering Flux.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
Diamond Electric Co.
Hoskins Mfg. Co.
Simplex Electric Heating Co.
Vulcan Electric Heating Co.

Solenoids.
Cutler-Hammer Mfg. Co.
Independent Elec. Mfg. Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Speedometers.
Elec. Speedometer Co.

Splicing Compound.
Massachusetts Chemical Co.

Springs.
Barnes Co., Wallace.
Cary Springs Works.
Dunbar Bros. Co.

Stage-Lighting Apparatus.
Condit Electrical Mfg. Co.
Frink, I. P.
Johns-Manville Co., H. W.

Staples. (See Insulating Materials, Staples.)

Starters.
Allen-Bradley Co.
General Electric Co.

Steel.
American Bridge Co.

Stoves, Mechanical.
Green Engineering Co.

Stokers, Electric.
Cutler-Hammer Mfg. Co.
Diamond Electric Co.
Hoskins Mfg. Co.

Strainers.
Elliott Co.

Supplies. (Electric Railway.)
Johns-Manville Co., H. W.
Western Electric Co.

Supplies. (General Electrical.)
Central Electric Co.
Doubleday-Hill Elec. Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Montgomery & Co.
Ostrander & Co., W. R.
Union Electric Co.
Western Electric Co.

Supplies, Telephone.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Switchboard Mats.
Massachusetts Chemical Co.

Switchboard Supplies.
Condit Electrical Mfg. Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Switchboards.
Allis-Chalmers Co.
Central Electric Co.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Stromberg-Carlson Tel. Mfg. Co.
Triumph Electric Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switchboards, Telephone.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Switches.
Cutler-Hammer Mfg. Co.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Knife.
Condit Electrical Mfg. Co.
Cutter Co.
Detroit Fuse & Mfg. Co.
Trumbull Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Oil.
Condit Electrical Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Snap.
Cutler-Hammer Mfg. Co.
Freeman Electric Co., E. H.
General Electric Co.
Hart Mfg. Co.

Switches, Time.
Reliance Automatic Lighting Co.

Tablet Boards.
Bossert Co.

Tachometers.
Biddle, J. G.
Elec. Speedometer Co.
Industrial Instrument Co.
Queen & Co., Inc.
Roller-Smith Co.

Taps & Dies.
Carpenter Tap & Die Co., J. M.

Telephones.
Manhattan Electrical Sup. Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Testing Apparatus.
Biddle, J. G.
Esterline Co.
Gurley, W. & L. E.
Leeds & Northrup Co.
Queen & Co., Inc.
Roller-Smith Co.

Testing, Electrical.
Electrical Testing Laboratories.

Testing Laboratories.
Electrical Testing Laboratories.

Theatre Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

Thermometers.
Industrial Instrument Co.
Leeds & Northrup Co.
Queen & Co., Inc.

Tools, Construction.
Cincinnati Tool Co.
Klein & Sons, Mathias.
Montgomery & Co.

Tools, Linemen's.
Cincinnati Tool Co.
Klein & Sons, Mathias.

Towers, Transmission.
Archbold-Brady Co.

Transformers.
Allis-Chalmers Co.
Central Electric Co.
Crocker-Wheeler Co.
Duncan Electric Mfg. Co.
Enterprise Electric Mfg. Co.
Esterline Co.
Fort Wayne Electric Works.
General Electric Co.
Moloney Electric Co.
Packard Electric Co.
Pittsburgh Transformer Co.
Triumph Electric Co.
Wagner Elec. Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Transformers, Bell Ringing.
Westinghouse Elec. & Mfg. Co.

Triplex Blocks.
Yale & Towne Mfg. Co.

Trolley Wheels.
Doubleday-Hill Elec. Co.
Union Electric Co.

Turbines, Steam.
Allis-Chalmers Co.
Ball & Wood Co.
De Laval Steam Turbine Co.
General Electric Co.
Western Electric Co.
Westinghouse Machine Co.

Turbines, Water.
(See Hydraulic Machinery.)

Vacuum Cleaners.
Perfex Cleaner Co.

Vacuum Drying and Impregnating Apparatus.
Buffalo Found'y & Mach. Co.

Valve Disks.
Jenkins Bros.

Valves.
Elliott Co.
Jenkins Bros.
Pittsburg Valve Foundry & Construction Co.
Sundh Electric Co.

Valves, Cylinder Relief.
Ludlow Valve Mfg. Co.

Valves, Pump.
Jenkins Bros.

Waterproofing.
Mitchell-Rand Mfg. Co.

Water Purifying System.
Harrison Safety Boiler Works.

Water Wheels and Turbines.
Allis-Chalmers Co.
Dayton Globe Iron Works.
Leffel & Co., James.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Trump Mfg. Co.

Water Wheel Governors.
Lombard Governor Co.
Ludlow Valve Mfg. Co.
Woodward Governor Co.

Wattmeters, Watt-hour Meters.
(See Instruments, Electrical.)

Welding Apparatus.
Engineering Products Co.
Garwood Elec. Co.

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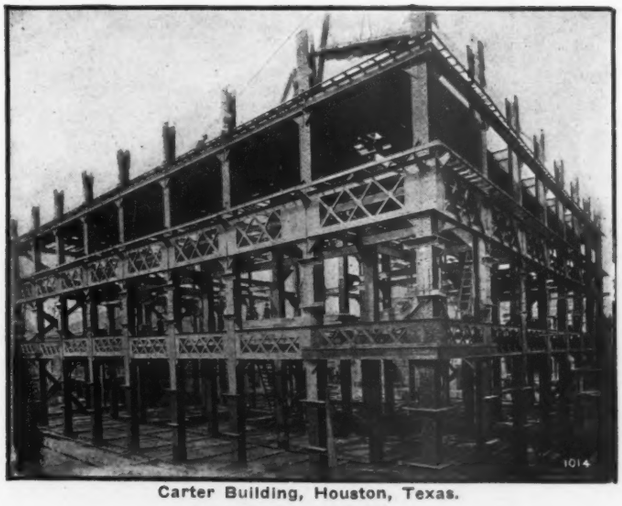

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KVA.			Speed
1	45	Westinghouse, single	900
1	65	Stanley, 2-phase	900
1	75	Gen. Elec., 3-phase,	900
2	75	Gen. Elec., 2-phase, type A.Q.B.	900
2	75	Gen. Elec., 3-phase, type A. T. B.	900
2	90	Gen. Elec., type AS.	900
1	90	Elec. Mach. Co., 3-phase	720
1	100	Gen. Elec., 3-phase,	900
1	100	National, 3-phase, 6600 v.	900
1	100	Gen. Elec., 3-phase, type A. T. B.	900
1	100	Gen. Elec., 3-phase, type A. T. B.	900
1	120	West., 2-phase	900
1	120	West., 3-phase	900
2	150	Westinghouse	600
1	150	Ft. Wayne,	450
1	150	West., 2-phase	600
1	150	National, 2-phase	720
1	150	National, 3-phase	720
2	150	Westinghouse, 2-phase, 2300 volt, revolving field type, direct connected to 16 x 16 Erie City Engines, special bargain, immediate delivery. Price $2500.00 each. F.O.B. Pittsburg.	225
1	150	West., 3-phase, rev. arm., comp., 220 or 440 v., dir.-con. to Harrisburg stand. comp. engine	240
1	175	Stanley, 2-phase	514
1	180	West., 2-phase	514
1	180	West., 3-phase	514
3	200	Gen. Elec., type A.-T.B.	800
1	300	Gen. Elec., type A.-S.B.	450
1	240	Gen. Elec., type A.-T.B., 3-phase, 60 cycle, 2300 v., dir.-con. to Harrisburg 4-valve engine	200

25 Cycle Alternators

KVA.			Speed
1	275	Westinghouse, 3-phase, rev. field, 6600 v., with excit.	350
1	400	Westinghouse, 3-phase, 440 v., rev. armature type, 3-bearing	300

125-133 Cycle Alternators

KVA.			Speed
1	30	National, 1100 volts.	1500
1	30	Gen. Elec., type A30.	1500
1	30	Gen. Elec., type AS.	1500
1	60	Ft. Wayne, 1100 v.	1400
1	60	Gen. Elec., A60.	1500
1	60	Westinghouse	1333
2	75	Ft. Wayne, comp.	1050
1	90	Ft. Wayne, 1100 v.	1050
3	90	Gen. Elec., type AS.	1250
1	100	Ft. Wayne	1050
1	120	Gen. Elec., A120	1070

Arc Machines

			Speed
1	6.6	amp., Brush, 8½ B.	570
1	6.6	amp., Brush, 10 B.	600
1	6.6	amp., Brush, 12 B.	500
2	9.6	amp., Brush, 12 A.	500

125-Volt D. C. Multipolar Comp. Generators

Lights			Speed
1	80	Ft. Wayne, 5 KW.	1700
1	150	Roth, 9 KW.	1300
1	150	Crocker-Wheeler.	950
2	150	Cincinnati, 8½ KW.	1100
1	150	Western Elec., 9 KW.	800
1	180	Amer. Eng. Co.	1350
1	180	Ideal, 10 KW.	1200
1	200	Commercial, 12 KW.	1300
1	200	Crocker-Wheeler.	1250
	210	Robbins & Myers.	1200
1	210	Western Electric.	1600
1	210	Sprague, 12½ KW.	1550
1	210	Gen. Elec., 12½ KW.	1200
1	210	C. & C., 12 KW.	900
4	250	National, 15 KW.	1700
1	270	Northern, 15 KW.	1300
1	207	Northern, 15 KW.	1125
1	270	Fairbanks-Morse.	800
1	270	Westinghouse, 15 KW, direct-con. to Westinghouse 2-cylinder gas engine.	325
1	300	Northern, 17½ KW.	1000
1	350	Ft. Wayne, 20 KW.	1200
1	350	Elec. Mach. Co.	850
1	350	Western Elec.	675
1	450	Gen. Elec., 25 KW.	1100
1	450	Gen. Elec., 6-pole, dir.-con. to Fitchburg engine	305
2	450	Westinghouse, 25 KW, dir.-con. to Westinghouse 2-cylinder gas eng.	300
1	540	Eddy, 25 KW	900
2	540	Crocker-Wheeler.	825
2	600	Northern, 35 KW., engine type without bearings, for dir.-con.	360
1	660	Western Elec.	475
1	700	Gen. Elec., 40 KW.	620
1	950	Gen. Elec., 55 KW.	925
1	950	Westinghouse, 56½ KW., dir.-con. to Erie-Ball engine	280
1	1050	Walker, 62½ KW.	690
1	1300	Card, 75 KW.	500
1	1300	Westinghouse	750
1	1600	Gen. Elec., 90 KW.	750
1	1600	Crocker-Wheeler, 90 KW.	550
1	1800	Westinghouse, 100 KW., dir.-con. to Ideal engine	250
1	2400	Western Elec., 125 KW., dir.-con. to Erie City engine	225

250-Volt D. C. Multipolar Comp. Generators

KW			Speed
1	6	Northern.	900
1	10	Holtzer-Cabot.	1475
1	10	Western Electric.	1400
1	12½	Ideal.	1100
4	12½	Gen. Electric.	1350
1	13½	Gen. Elec.	850
4	17½	Colonial.	1200
1	20	Commercial.	750
1	20	Western Electric.	750
1	20	Crocker-Wheeler, dir.-con. to Terry 30 H. P. steam turb	2500
1	22½	Crocker-Wheeler.	880

KW			Speed
1	25	Akron.	1200
1	25	Western Elec.	650
2	25	Gen. Elec.	1050
1	25	Allis-Chalmers.	975
1	25	Westinghouse	650
1	30	Western Elec.	950
1	30	Allis-Chalmers.	1300
1	30	Elec. Mach. Co.	950
1	30	Amer. Eng. Co.	750
1	30	Commercial.	600
1	30	Ideal.	600
1	30	Crocker-Wheeler.	800
1	35	Northern.	1000
1	35	C. & C.	750
2	35	Western Elec.	500
1	37½	Triumph.	1000
1	40	C. & C.	600
1	45	Northern.	900
1	45	Westinghouse.	690
1	45	Western Elec.	500
1	60	C. & C.	650
1	100	Jenny, dir.-con. All-free engine	250
2	125	C. & C.	470
1	200	Gregory-Vincent.	475

550-Volt D. C. Multipolar Comp. Generators

KW		Speed
1	25	Triumph. 950
1	35	Northern. 725
2	200	Westinghouse. 510

220-Volt D. C. Motors

H.P.			Speed
1		½ Submerged Motor Co., encl.	625
1	1	Peerless, MP.	1500
2	1	Submerged Motor Co., encl.	675
1	1	Gen. Elec.	900
1	1½	Crocker-Wheeler.	1250
3	2	Northern series, crane or hoisting motors.	800
1	2	Northern, MP, series	1000
1	2	Fidelity, MP.	1000
3	2	Willey, MP.	1330
2	2	Watson, MP, new.	1200
1	2	Fairbanks-Morse, M-P, back-geared.	1550–387
3	2½	Submerged Motor Co., encl.	540
1	3	Willey, MP.	1460
2	4	Willey, MP, comp.	900
1	4	Eddy, MP.	700
1	5	Hobart, MP.	1100
1	5	Northern, MP, comp	1450
1	5	Willey, MP, comp.	1200
4	5	Gen. Elec.	1100
1	5	Westinghouse, MP.	950
50	5	National, MP.	950
1	6½	Crocker-Wheeler.	1225
2	7½	National, MP.	1450
2	7½	Northern, MP.	1400
1	7½	National, MP.	1200
1	7½	Sterling, MP.	900
1	7½	Fidelity, MP.	850
15	7½	National, MP.	1100
1	7½	Gen. Elec., MP.	1525
39	7½	National, MP, shunt.	900
11	7½	National, MP, comp.	900
1	7½	Commercial, MP.	540
1	10	Western Elec., MP.	1550
12	10	National, MP, new.	1500
1	10	Storey, enclosed series, crane or elevator motor.	600
2	10	Gen. Elec., MP.	1375
1	10	Roth, MP.	810
69	10	National, MP, shunt	800
1	10	Allis-Chalmers, MP.	950
1	10	Fairbanks-Morse, M-P, backgeared.	950–100

H.P.			Speed
1	10	Westinghouse, MP.	750
1	15	Roth, MP.	750
37	15	National, MP.	725
2	15	Gen. Elec., MP.	690
1	20	Gibbs, MP.	600
1	20	Gen. Elec., MP.	1040
1	20	Gen. Elec., MP.	650
20	20	National, MP.	625
1	25	Commercial, MP.	650
1	25	Fisher, MP.	650
3	25	Crocker-Wheeler.	700
2	25	Elektron, MP.	360
1	30	Western Elec., MP.	1000
1	30	National, MP.	950
1	30	Western Elec., MP.	900
1	30	Allis-Chalmers, MP.	875
1	30	Western Elec. MP.	600
1	30	Northern, MP.	520
5	30	National, MP.	575
1	30	Westinghouse, MP.	600
1	35	Western Elec., MP.	850
1	35	Allis-Chalmers, MP.	1150
1	35	Commercial, MP.	550
1	35	Elec. Mach. Co., MP.	850
1	35	Ideal, MP, type D.	550
1	35	Crocker-Wheeler.	665
2	35	Gen. Elec.	610
3	35	Gen. Elec., MP.	550
1	20	Northern, MP., comp	900
1	40	C. & C., type MPI.	650
1	40	Western Elec., MP.	450
1	45	National, MP.	825
1	55	Northern, MP.	800
1	55	Westinghouse, MP.	625
1	75	Crocker-Wheeler.	800

3-Phase, 60-Cycle A. C. Motors

H.P.			Speed
1	3	Gen. Elec., 220 v.	1800
1	3	Westinghouse,	1700
1	5	Gen. Elec., 220 v.	1800
1	5	Westinghouse,	1700
1	5	National, 220 v.	1200
2	5	Gen. Elec., 220 v.	1200
1	5	Westinghouse,	1120
2	7½	Gen. Elec., 220 v.	1800
1	10	Triumph, 440 volts.	1750
1	10	Westinghouse,	1720
1	10	Wagner, 220 volts.	1700
2	10	Gen. Elec., 220 v.	1200
1	10	Westinghouse,	850
1	10	Westinghouse,	850
1	15	Fairbanks - Morse, 220 volts.	1200
1	15	Westinghouse,	1120
1	20	Fairbanks - Morse,	900
1	20	Westinghouse,	1120
1	25	Ideal, 440 volts, slip-ring type.	1120
1	25	Gen. Elec., 220 v.	900
1	75	Westinghouse,	840
1	75	Westinghouse, slip-ring, 220 volts.	690
2	200	Westinghouse, 220 or 440 volts.	580
1	200	Westinghouse, 2220 volts.	580

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1—25 KW., Bullock, 4 pole, 750 RPM.
1— 7½ HP., Crocker-Wheeler, "CM," 4 pole, 875 RPM.

DIRECT CURRENT DYNAMOS AND MOTORS—250 Volts

1—125 KW., Western Electric, 6 pole, 575 RPM.
1—100 KW., Fort Wayne, 6 pole, 550 RPM.
1— 80 KW., Crocker-Wheeler, "DC," 4 pole, 650 RPM.
1— 65 HP., G. E., type, "CL-B," 540 RPM.
1— 60 KW., Northern, 4 pole, 800 RPM.
1— 55 HP., Westinghouse, "S," 4 pole, 825 RPM.
1— 50 HP., Westinghouse, 4 pole, 1050 RPM.
1— 40 HP., Western Electric, 1000 RPM.
1— 35 HP., Northern, 4 pole, 400/800 RPM.
1— 30 HP., G. E., "CL-B," 965 RPM.
3— 25 HP., Crocker-Wheeler, "CM," 4 pole, 750 RPM.
3— 25 HP., Western Electric, 4 pole, 1000 RPM.
1— 15 HP., Westg., vertical, "S," 4 pole, 1425 RPM.
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1— 10 HP., Northern, 4 pole, 600/1200 RPM.
1— 10 HP., Crocker-Wheeler, "DDM," 4 pole, 1260 RPM.

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90	General Electric	2300	1	300	11 & 19x12 Erie Ball.
100	T. Ryan.....	550	3	257	14x16 Ridgway.
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2—100	Stanley.....	2300	2 or 3	250	13 & 20x14 Ames.
125	Westinghouse....	1100	2 or 3	240	13 & 22x14 Erie Ball.
135	Westinghouse....	6600	3	200	None
4—150	General Electric.	2300	3	225	16x20 Ball and Wood.
250	General Electric.	2300	1	200	15 & 26x16 Ames.
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300	Westinghouse....	1100	1	100	24x42 Harris'g. Corliss.
330	Stanley.....	2400	2 or 3	165	19 & 35x24 Harrisburg.
360	Stanley.....	2400	2 or 3	182	Cross Comp. Williams.
400	Westinghouse....	1100	2	150	16 & 32x30 Harris'g Corliss
500	Westinghouse....	220	2 or 3	144	21 & 38x30 Harris'g Corliss
500	General Electric.	2300	2 or 3	1800	Curtis 2 stage.
750	Stanley.....	2300	2 or 3	90	24 & 48x48 Corliss C.C.
800	General Electric.	1200	1	90	26 & 42x54 Corliss C.C.
800	Westinghouse....	180	2	180	30 & 48x24 Vertical C.C.
2-1000	General Electric.	550	3-40 cy.	120	30 & 60x30 Corliss C.C.
2000	General Electric.	6600	2	106	Hor. C.C. Corliss.

We Also Have a Large List of Belted A. C. and D. C. Generators

WE SELL SECOND-HAND MOTORS

MACHINERY BROKERAGE CO.

60 CHURCH STREET NEW YORK CITY

FOR SALE

150 K. W. Westinghouse Generator Set direct connected to Erie City 4 Valve Engine. R. P. M. 170, Volts 220, Cycles 25.

Address No. 8694

Care of Electrical World NEW YORK

FOR SALE

100-horse-power gas engine generator set. Engine, 120-horse-power Riverside Tandem, 200 rpm. Producer, 125-horse-power Smith suction producer. Generator, General Electric ATB., 75-kilowatt, 230 volts, 3-phase, 60-cycle. Plant complete with all auxiliaries. Write us for detail description and prices.

Rochester Railway and Light Company, Rochester, New York

FOR SALE

2 Western Electric Arc Dynamos, good condition, latest type, 6.8 amp., 4500 volts; also sixty Thompson Imp. K. 12 open arc lamps, 6.8 amperes.

Merrill Railway and Lighting Co , Merrill, Wis.

DUZETS & SON

ELECTRICAL AND STEAM MACHINERY

HUDSON TERMINAL BLDG. NEW YORK

SPECIAL: Two 100 K. W. Wghse. 550-volt generators, dir. con. Porter Allen 4 valve engines.

DIRECT CURRENT 550-VOLT APPARATUS

Two 75 K. W. G. E. rotaries, 60 cy. 3 ph.-550 volts.
1600 K. W. G. E. generator, dir. con. Corliss cross comp. engine.
500 K. W. G. E. generator, dir. con. Corliss cross comp. engine.
425 K. W. G. E. generator, dir. con. Corliss cross comp. engine.
300 K. W. G. E. generator, dir. con. Corliss tandem engine.
500 K. W. Bullock 6 pole generator, 375 RPM.
150 K. W. G. E. 6 pole generator, 400 RPM.
[illegible] generator, 600 RPM.
75 K. W. Standard 6 pole generator, 600 RPM.

HEAVY DUTY ENGINES

[illegible] 4 valve tangye frame.
20 x 27 Russell 4 valve tangye frame.
[illegible] tangye frame.
18 x 36 Slater Corliss tangye frame.
17 x 16 Skinner automatic.
16 x 16 Erie Ball, automatic.
11 x 16 Atlas 4 valve, tangye frame.
10 x 12 Ames, automatic.

BOILERS

Two 250 H. P. Heine watertube, 160 lb. steam pressure.
72" x 18' H. R. T. boiler, 125 lb. steam pressure.
72" x 16' H. R. T. boiler, 125 lb. steam pressure.
66" x 16' H. R. T. boiler, 110 lb. steam pressure.
Send for complete "Bargain List."
Generators, Motors, Engines, Boilers, etc.

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words, two cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

ENGINEERS and draftsmen have their records complete on file with us at all times and employers will find it to their advantage when looking for men of this type to communicate with us. Inquiries solicited. THE ENGINEERING AGENCY, Inc., Monadnock Block, Chicago.

DO you need new blood in your business? Do you need an active man that can do things? Somebody that can get results as well as you can yourself? Do you need a man that can put his shoulder to the wheel and make things hum? A young man entering the prime of life, trained to deliver the goods by one of the largest corporations in America. I am that man, and my services are for sale. I am looking for the firm that needs me. Address No. 8701, care of Electrical World, New York.

RESPONSIBLE position wanted; several years' experience in transformer and insulating practice; extra high voltage apparatus especially; A1 references. Address No. 8733, care of Electrical World, New York.

YOUNG MAN, 22 years of age, taking electrical engineering course at night, desires situation; has had 6 months' experience in railroad signal work and 7 months' experience in underground electrical feeder work; excellent draftsman; executive ability. Address No. 8751, care of Electrical World, New York.

MECHANICAL and electrical engineer of wide experience with several large industrial companies open for position Aug. 15; present position includes full charge of installation of 450 motors, substation, heavy plant machinery, pipe lines, etc.; technical graduate, E.E. Address No. 8691, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

YOUNG MAN, able, technical graduate in electrical engineering, has had 3 years' practical experience, wishes to obtain position with an electrical firm where there are chances for advancement. Address No. 8739, care of Electrical World, New York.

POSITION wanted by young engineer, technical graduate with 7 years' practical experience in construction, operation and maintenance of power plants, substations, power and railway installations; at present employed, but desire change of location; East or Middle West preferred. Address No. 8753, care Electrical World, New York.

ENGINEER salesman, experienced in sale of high-grade steam and electrical machinery, both large and small, central station experience in sale of current for all uses; with large manufacturer; change of location desired; references given. Address No. 8740, care of of Electrical World, New York.

WANTED—Situation as electric wireman inside; used to doing house wiring, bell work, etc., and a little experience of outside work. Address No. 8738, care of Electrical World, New York.

CENTRAL STATION maanger, 30 years old, married; 10 years' experience, covering shop, office and new business-getting; both light and power; am now assistant to one of the very best central station managers in the business, serving a field of 100,000 population; electrical engineer, college graduate; prefer the management of a company where a capable and tactful man is required. Address No. 8752 Electrical World, New York.

I WILL INSTALL your electrical equipment and guarantee first-class installation; 10 years' practice in erection and operation of mining, milling and industrial power plants; hydroelectric plants a specialty; familiar with Latin-American language and labor; best of references. "CONSTRUCTING ENGINEER," Box 635, El Paso, Tex.

SUPERINTENDENT OR MANAGER, experienced in factories, sales, and operating, several years' service with largest firms, well acquainted with latest electrical manufacturing developments, good on organizing, and economical, rapid production of high quality work. Address No. 8732, care of Electrical World, New York.

ATTORNEY, admitted 1905, formerly with New York Public Service Commission for several years, having a well-grounded experience, desires legal position where his knowledge of public utilities work may be advantageously used. G., Room 1001, 302 Broadway, New York City.

NEW BUSINESS MANAGER, modern methods, illumination, power, equipment, heating appliances, signs, advertising; power expert; experienced engineer salesman with large company; change of location desired. Address No. 8741, care of Electrical World, New York.

POSITION WANTED as sales engineer by good all-round man having 16 years' experience in engineering and commercial work. Just the man to represent you where combined engineering and sales ability are necessary; age 39; single; energetic and conscientious; A-1 references. Address No. 8743, care of Electrical World, New York.

EXPERIENCED meter man, technically educated, at present employed by one of the large electric light companies, wishes to change; position as meter chief of a progressive company or that of assistant superintendent, in connection with it desired. Familiar with line construction and central station engineering. Address No. 8711, care of Electrical World, New York.

POSITIONS VACANT

The rate for "Positions Vacant" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

MERITORIOUS INVENTIONS often bring profits, if not fortunes; mail description of invention for free, candid opinion and estimate to apply for patent. Delay dangerous. Edward P. Thompson, M. E., Registered Patent Solicitor. Established 20 years. Served hundreds of Electrical World readers. Victor Bldg., Washington, D. C.

RESIDENT AGENTS and salesmen in cities and industrial centers on commission basis wanted by manufacturers of complete lines of incandescent lamps. Address No. 7538, care of Electrical World, New York.

SALESMEN AND AGENTS on commission basis desired by manufacturer of refilled incandescent lamps. A good paying side line for any electrical supply salesman. Address No. 8569, care of Electrical World, New York.

WANTED—Man to take charge of new business department of electric light and power company in large city in Eastern Pennsylvania; must be thoroughly experienced, good executive and able to inject the necessary ginger and enthusiasm into the department; state age, experience, references and salary. No. 8717, care of Electrical World, New York.

WANTED—Department foreman, a man to take full charge of 50 to 75 men; must be thoroughly familiar with modern methods and have ability to handle men to the best advantage and produce results; good position for the right man; reference required. Address, stating full particulars, Box 8726, care of Electrical World, New York.

ELECTRICAL manufacturing company in Chicago wants the services of a shop foreman who has had experience in building switchboards, panel boards and steel cabinets; a first-class opening for the right man; give reference, experience, and state salary wanted. Address No. 8727, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

WANTED—Advertising man, young, capable of handling details and writing advertisements on gas, electrical and steam power machinery for agricultural and engineering papers; good, permanent proposition with a large manufacturer. Address No. 8728, care of Electrical World, New York.

DEVELOPMENT LABORATORY wants electro-technically trained man (preferably recent graduate), with experience as draftsman and machinist; state full particulars and pay expected. S. L., P. O. Box 232, Hartford, Conn.

DRAFTSMAN wanted, accustomed to the layout of d.-c. motors and generators. In replying, please state experience and references. Moderate salary. Address 8736, care of Electrical World, New York.

WANTED—Several high class, electrical supply and specialty salesmen, thoroughly familiar with the trade and selling conditions in any of the following territory: Louisiana, Mississippi, Alabama, Texas, New York State, New England. Can secure permanent positions with a manufacturer, with a chance for advancement, as soon as ability is proven. To insure reply, application should be in writing, stating fully experience, territory covered, two or more commercial references and salary to start. Address No. 8730, care of Electrical World, New York.

WANTED—First-class electrical engineer who has had several years' practical experience in the construction of ore and coal handling machinery; state experience and salary required. Address No. 8723, care of Electrical World, New York.

YOUNG man with some technical training to assist in preparing physical records of electric property; promising and permanent position to right party; state references, training and wages. Address No. 8716, care of Electrical World, New York.

WANTED—One first-class electrical draftsman at $5.04 per diem, one first-class assistant electrical draftsman at $4 per diem, one first-class copyist electrical draftsman at $3.28 per diem and one second-class copyist electrical draftsman at $3.04 per diem. A competitive examination will be held July 24, 1911, for the purpose of filling the above positions. For further information address "Commandant, Navy Yard, Puget Sound, Wash."

ELECTRICAL SALESMAN wanted by one of the largest manufacturers of electrical products; must have wide practical experience in central station, street railway and general supply selling; exceptional opportunity for an experienced, capable and energetic man for permanent connection. Write in confidence, stating experience, salary, references, etc. Address No. 8720, care of Electrical World, New York.

FIRST-CLASS mechanical and electrical engineer required for England, with thorough experience in modern manufacture of continuous current and alternating current machinery; must be used to the control of men; state full qualifications and salary required to No. 8721, care of Electrical World, New York.

WANTED—Working test room foreman by New England company manufacturing D. C. motors and generators and small A. C. motors; state age, experience and salary expected. Address No. 8697, care of Electrical World, New York.

WE have an excellent opening for a contractor with plenty of push and two or three thousand dollars in cash. Address No. 8692, care of Electrical World, New York.

WANTED—Working foreman for a small shop employing 5 or 6 men in the manufacture of electrical specialties; must be a good mechanic and understand electrical instrument work. Must be willing to use tools as well as lay out work and superintend. Applicants must give reference and state experience and wages desired. Write fully, No. 8654, care of Electrical World, New York.

WANTED—One first-class assistant electrical draftsman at $4 per diem; a competitive examination will be held June 28, 1911, for the purpose of filling the above position. For further information address "Commandant, Navy Yard Station, Portsmouth, Va."

WANTED—One first-class assistant marine electrical draftsman at $4 per diem; a competitive examination will be held June 30, 1911, for the purpose of filling the above position. For further information address "Commandant, Navy Yard, Philadelphia, Pa."

WANTED AT ONCE—Salesman and purchasing agent capable of taking charge of large stock new and second-hand dynamos and motors; requirements, good business judgment, must be a live, energetic salesman, must possess a thorough knowledge of value and construction all makes and types of machine; must be experienced and furnish first-class reference. Address below, outlining experience and salary expected, No. 8688, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

LARGE manufacturer wants energetic man to sell, and supervise the sale by others, of electric motors to industrial establishments where the use of motors is practical; an electrical education, experience in selling and with motor application are preferable, but conscientious work and enthusiasm are essential; permanent position, good salary and opportunity to advance for the right man. Reply fully, giving age, experience and references, No. 8689, care of Electrical World, New York.

(Continued on page 78)

Many a Big Company Is Misjudged

by the buying public because they are small advertisers. How many of your customers have seen your factory or know anything of your facilities beyond what they have learned from your advertising?

Make your advertising, therefore, thoroughly representative of your plant.

Don't expect strangers to recognize you as leaders if your advertising looks small and unimportant.

Blow your *own* horn and the public will take up the refrain.

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire.
All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting.
Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick **50c PER STICK** **$5.00 PER DOZ.**

For Sale by all Supply Houses or **K. McLENNAN & CO.** Sole Manufacturers
Room 411—130 Dearborn St., CHICAGO

THE COAL & IRON NATIONAL BANK

143 LIBERTY STREET
NEW YORK

ASSETS
$8,000,000

Exceptional facilities for out-of-town accounts

2

Substantial Progress

of the

Electric Light and Power Industry

We have prepared a pamphlet showing, with many comparisons, the relative development of the physical, investment and earning features of this important industry during the last decade.
This pamphlet, entitled "The Commercial Development of the Electric Light and Power Industry," *will be sent on request.*

Electric Bond and Share Company

Paid-up Capital and Surplus, $5,280 000
71 Broadway, New York

Learn Electricity

One-Year Practical Course in ELECTRIC WIRING

Two-Year course in Practice and Theory for Young Men Who Wish to Become Master Mechanics, Foremen, Inspectors, Etc., in ELECTRICAL CONSTRUCTION AND OPERATION. Also ONE AND TWO-YEAR COURSES IN SIX OTHER TRADES, at

WENTWORTH INSTITUTE

Boston, Mass.
WRITE FOR CATALOGUE AND PARTICULARS
Tuition Fee $6.00 per term. 2

COMMONWEALTH EDISON CO.

REPAIR SHOPS

32 N. MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS.

CORRESPONDENCE SOLICITED

POSITIONS VACANT

(*Continued from page 76.*)

WANTED—Electrical supply salesman for Southern Minnesota, one that is at present traveling that territory. Will pay liberal salary and expenses. Good opportunity for advancement for the right man. All replies kept strictly confidential. Address No. 8673, care of Electrical World, New York.

WANTED—Electrical Supply Salesman for the States of Wisconsin and Upper Peninsula of Michigan, one that is at present traveling that territory. Will pay liberal salary and expenses. Good opportunity for advancement for the right man. All replies kept strictly confidential. Address No. 8672, care of Electrical World, New York.

WANTED—Electrical draughtsman on transformers and induction motors; state age, experience and saalry expected. Address PACKARD ELECTRIC CO., St. Catherines, Ont.

WANTED—High-grade sales engineer; preference given to one with some refrigerating expereince; for New York territory by large company manufacturing A. C. and D. C. motors and generators; salary and commission. Address No. 8746, care of Electrical World, New York.

SOLICITORS who have had experience in the following branches or who are good all around solicitors, large power contracts, sign and outline, residence lighting and general small motor business; location, Western Canada. Immediate engagement. Salary to start, $100 to $150 a month with good prospects of advancement to the right men. Address No. 8749, care of Electrical World, New York.

EXPERIENCED ENGINEER, preferably a technical graduate, familiar with laying out of overhead distributing system, three-phase and single-phase, knowledge of underground distribution desirable, but not essential; location, Western Canada; salary to start $125 to $150 a month with good prospects of advancement to right man; immediate engagement; applicants requested to give full information as possible in the first letter. Address No. 8748, care of Electrical World, New York.

WANTED—By a large manufacturer of electrical goods, foreman to take charge of manufacturing of high-grade electric light fixtures; must be a thoroughly competent mechanic, familiar with manufacturing details; exceptional opportunity for an experienced and capable man; write in confidence, stating salary, reference, experience, etc., to No. 8750, care of Electrical World, New York.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y.—Courses in Civil, Mechanical and Electrical Engineering and General Sciences, leading to the degree of Civil Engineer (C.E.), Mechanical Engineer (M.E.) Electrical Engineer (E.E.) and Bachelor of Sciences (B.S.). Special courses in Engineering and Sciences. Splendidly equipped new engineering laboratories. Send for catalogue to the Registrar.

BLISS ELECTRICAL SCHOOL, Washington, D. C.—Course complete in one year. Thorough, practical, scientific. Theoretical and applied electricity, mechanical drawing and necessary engineering knowledge. No superficial or non-essential studies. Actual construction, installation and testing. For young men of energy and character. In the heart of America's Scientific enterprise and research. Opens Sept. 20. Write for catalogue. Address 25 Takoma Ave.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

WANTED—A large and well-equipped factory; will make under contract or on royalty metal specialties; electrical heating devices preferred; will buy outright any patent article of merit. For further information address No. 8380, care of Electrical World, New York.

ATTRACTIVE OPPORTUNITY—By virtue of an Order of Sale issued out of the Court of Common Pleas of Henry County, Ohio, to me as special master commissioner, I will, ON FRIDAY, THE 30TH DAY OF JUNE, 1911, offer for sale at public auction, at the Court House in Napoleon, Ohio, at 10 o'clock A. M., the property of the Napoleon Home Telephone Company, as an entirety. Said property consists of six (6) telephone exchanges, all located in Henry County within a ten-mile radius of Napoleon, in which latter town the main exchange is situated. The property is in good working condition; total number of subscribers 1,366; gross monthly income approximately $1,900. Splendid opportunity to develop and increase at nominal cost. Working agreement with Bell Company and no opposition from latter in County. Ninety miles of toll lines owned and operated in County. Two (2) good pieces of real estate included in the sale, together with thoroughly satisfactory franchises covering various exchanges and contracts with neighboring companies operating small mutual exchanges. One hundred miles of pole lines in good condition. Entire system magneto. Entire property appraised at $38,542. Since appraisement by order of the Court, approximately $3,500 has been expended in betterments. Terms cash, with certified check for $1,000 required to insure fulfillment of bid.

RALPH P. BROWN,
Special Master Commissioner.

FOR SALE—Modern factory, 50 x 120; practically fireproof; completely equipped for manufacture of gas and electric fixtures and fittings; model plating outfit and good foundry; stock of raw material; low taxes; American labor; equitable freight rates; New York Central and Pennsylvania R. R.; location ideal. Address MANUFACTURES BARGAINS, No. 8693, care of Electrical World, New York.

WANTED—500 or 750 kw. normal rated, 2-phase, 60-cycle, 2200 volt, horizontal turbine unit, with exciter, generator panel and condensing apparatus; give price, time of delivery and where could be inspected. Address No. 8724, care of Electrical World, New York.

WANTED—One second hand, in good condition, General Electric, 60 cycle, air-cooled, constant current transformer; 2200 volts primary; 6.6 amps. secondary; 100 lights capacity. CONSTANTINE HYDRAULIC COMPANY, THREE RIVERS, MICH.

FOR SALE—All capital stock of Weyauwega Electric Light Company, at auction, July 25, 11 o'clock, at flour mill, Weyauwega; minimum bid, $20,000; company owns sufficient water power; at same sale water power flour mill, village properties, flour and feed stock, notes and judgments. C. F. Crane, T. F. Wilson, Assignees, Weyauwega, Wis.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

TREASURY DEPARTMENT, OFFICE OF Supervising Architect, Washington, D. C., June 1, 1911.—Sealed proposals will be received at this office until 2 o'clock P. M., Friday, June 30, 1911, and then opened, for supplying and installing lighting fixtures in the U. S. buildings at Austin, Minn.; Beloit, Wis.; Clinton, Mo.; Decorah, Iowa; Fremont, Neb.; Kokomo, Ind.; Litchfield, Ill.; Plattsmouth, Neb., and Great Falls, Mont., in accordance with the drawings and specifications, copies of which may be obtained at this office, at the discretion of the Supervising Architect. The right is reserved to reject any and all bids, and to waive defects. Each proposal must be accompanied by a certified check in the sum of two per cent of the aggregate amount thereof, drawn to the order of the Treasurer of the United States, as a guarantee of good faith. Proposals should be addressed to the Supervising Architect, Treasury Department, Washington, D. C., and the envelope endorsed "Proposal for Lighting Fixtures, U. S. buildings at Austin, Minn.; Beloit, Wis.; Clinton, Mo.; Decorah, Iowa; Fremont, Neb.; Kokomo, Ind.; Litchfield, Ill.; Plattsmouth, Neb., and Great Falls, Mont." James Knox Taylor, Supervising Architect.

TREASURY DEPARTMENT, OFFICE OF Supervising Architect, Washington, D. C., June 16, 1911.—Sealed proposals will be received at this office until 2 o'clock P. M., Tuesday, July 18, 1911, and then opened, for supplying and installing lighting fixtures in the U. S. buildings at Demopolis, Ala.; Harriman, Tenn.; San Marcos, Tex.; Temple, Tex.; Troy, Ala.; Columbus, O., and Enid, Okla., in accordance with the drawings and specifications, copies of which may be obtained at this office, at the discretion of the Supervising Architect. The right is reserved to reject any and all bids, and to waive defects. Each proposal must be accompanied by a certified check in the sum of Two Hundred and Fifty Dollars, drawn to the order of the Treasurer of the United States as a guarantee of good faith. Proposals should be addressed to the Supervising Architect, Treasury Department, Washington, D. C., and the envelope endorsed: "Proposal for Lighting Fixtures, U. S. Buildings at Demopolis, Ala.; Harriman, Tenn.; San Marcos, Tex.; Temple, Tex.; Troy, Ala.; Columbus, O., and Enid, Okla." James Knox Taylor, Supervising Architect.

ATTENTION—CENTRAL STATION MANAGERS—Increase the revenue of your station. We specialize in the inspection calibration, repairing and testing of electrical meters on consumers' premises or at central station. Switchboard apparatus included. Expert instrument and meter-men only employed.

Correspondence solicited.

ELECTRICAL METER TESTING COMPANY
1547 Broadway, (Room 212), NEW YORK CITY

Reco FLASHERS
FOR ELECTRIC SIGNS AND DISPLAYS OF ALL DESCRIPTION

SAVING HALF IN CURRENT BILLS

increase advertising value of signs immeasurably—Immense line—reasonable prices.

Reynolds Electric Flasher Mfg. Co.
617-631 Jackson Boul., Chicago
Largest Manufacturers of Flashers in the World
New York, 1123 Broadway

FOR SALE

1—500 H.P., Greene, horizontal cross compound engine, belted. May be seen in operation. Will be sold at sacrifice to move quickly.

SALEM ELECTRIC LIGHTING COMPANY
201 Devonshire Street **Boston, Mass.**

FANS FOR SALE

FANS: Having recently taken over an isolated plant, we have as follows:

84—16″ G. E., 110-Volt, D. C. Desk Fans.
24—12″ G. E., 110-Volt, D. C. Desk Fans.
14—4 Blade G. E., 110-Volt, D. C. Ceiling Fans.

All in first-class condition. Bargain prices. Address

8744 care of ELECTRICAL WORLD, NEW YORK

Fill Up The Hollows In Your Load Curve

with the profitable day load which comes to the Central Station Manager who introduces

CENTURY
Single-Phase Motors

to his prospective customers.
They are reliable—durable—self-starting under load.
Built for any frequency between 25 and 140 cycles—¼ to 40 H.P.
Our bulletins describe them in every detail. Write for them—now.

CENTURY ELECTRIC CO.
19th and Olive Streets, St. Louis, Mo.
NEW YORK OFFICE: 30 CHURCH ST.

Why are
Burke Electric Co.'s
Three-Wire Generators Specified?

Write for Description and Prices

Burke Electric Co., Erie, Pa.
Offices Principal Cities 3

All that the name implies
PEERLESS MOTORS

Superior in Electrical and Mechanical design—1/30 to 30 H. P.
Direct current for every requirement.
Motor generator sets.
Rotary converters.
Desk and Ceiling Fan Motors

THE PEERLESS ELECTRIC COMPANY
Factory and Main Office: **WARREN, OHIO**
Sales agencies—all principal cities. 3

CROCKER-WHEELER
MOTORS
GENERATORS TRANSFORMERS

REMEK TRANSFORMERS

WHY NOT COMPARE
the different Transformers and select the most desirable?

ONE OF THE LARGE LIGHTING CO.'S

made a test of five of the leading Transformers with the following result:

	Core Loss, Watts	Total Full Load Loss by Wattmeter	Regulation in % at Unity P. F.
C. W. REMEK 15 KVA	84.0	295.00	1.34
No. 1—15 KVA. . .	90.0	312.80	1.42
" 2—15 KVA. . .	118.8	331.70	1.35
" 3—15 KVA. . .	131.0	344.00	1.35
" 4—15 KVA. . .	108.0	344.40	1.51

It will be noted that the Remek
SAVES FROM 12% to 50%
on core loss and a big saving in copper loss.

WRITE FOR REMEK BOOK "L" GIVING DETAILS

CROCKER-WHEELER CO.

OFFICE AND WORKS:
AMPERE, N. J.
Write for Booklet L on Remek Transformers.

Boston
Birmingham
Chicago
Cleveland
Denver
Detroit
Newark
New Haven
New York
Philadelphia
Pittsburg
Syracuse

This Outfit "Saves" For Your Customer—"Makes" For You

It saves time, money and bother in making all kinds of repairs of iron and steel parts. You make because of increased current use occasioned by the utilization of

Garwood Electric Welding Outfits

The work can be done as a rule without requiring extensive refinishing of repaired parts, and the outfit is extremely simple and reliable in operation. High efficiency—No Hard Welds.

Voltage regulation is entirely automatic, and grid resistanc s and water rheostats have been eliminated.

Detailed information is in our bulletin 508-A—yours upon request.

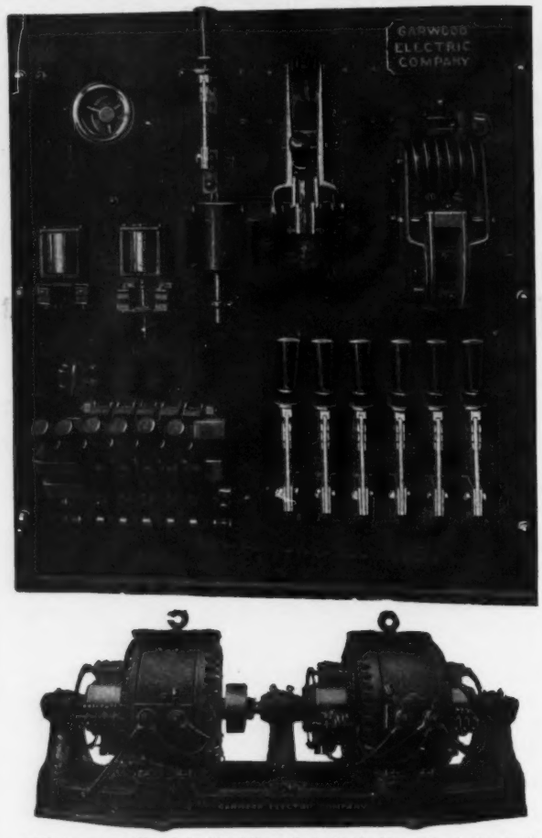
Garwood Electric Co.

Sole Manufacturers

Main Office and Works: GARWOOD, N. J.

Branches:

New York	Philadelphia	Boston	Denver
Chicago	St. Louis	Pittsburg	New Orleans



900-Ampere Electric Welding Set, Including Switchboard.

Why rely altogether on your own efforts?

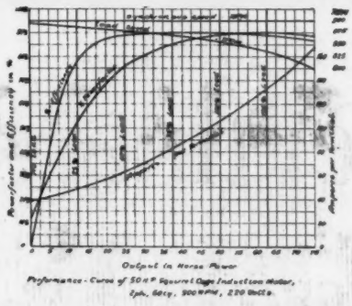
¶ The experience of others has paralleled your own.

¶ The fruits of their labor frequently take the form of some machine or device or service that would help you in your work.

¶ Many of these men are advertising in the Electrical World. They have something to say to you. Their message may solve some of your knotty problems. Look through the advertising pages every week; learn details of anything that may prove useful to you. A card to the advertiser brings you the information you want. Start with this issue.

Electrical World

239 West 39th St. New York



Performance-Curve of 50 H.P. Squirrel Cage Induction Motor, 1ph. 60cy. 900 R.P.M., 220 Volts.

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YOU know what you want a motor for and what you want it to do. We eliminate guess work from your motor buying. Just tell us what you want and we will submit a set of characteristic curves of our motor and guarantee them fully. If the characteristic don't look right, tell us so and we will show you curves of motors that more nearly meet your requirements. No buying in the dark; no unsatisfactory operations; nothing to worry about. Our guarantee protects you fully. Write for details of our proposition and ask for catalog on our direct current and alternating current generators and motors.

IDEAL ELECTRIC & MFG. CO.
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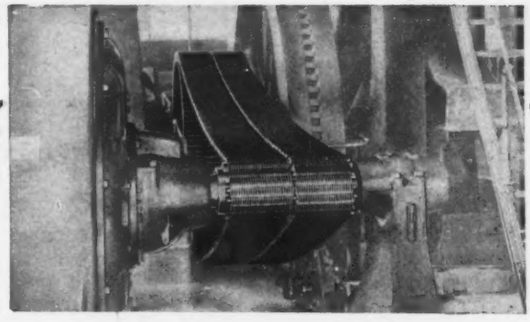

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admits of no shock nor lost motion, as in spur gears, nor any of the slipping, jerky unsteadiness common to belts.

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OF ANY TYPE, FOR ANY HEAD FOR ANY CONDITIONS

500,000 H. P. now in operation or under construction.

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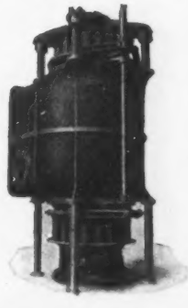

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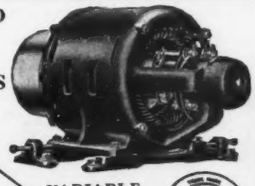
CONSTANT AND VARIABLE SPEED MOTORS



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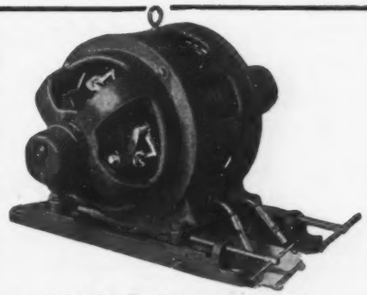
The Richmond Electric Co.

RICHMOND, VA.

LINCOLN Single Phase MOTORS



Self-starting under load. Torque up to four times full load torque at start. No phase splitters governors or other complications found in other single-phase motors.

We shall be glad to send details. Catalogs sent on request.

Lincoln Electric Company, Kelley Ave. & 38th St., Cleveland, O.
Write to the nearest representative: Muench Brothers, 90 West Street, New York City; Buffalo Electric Co., 17 W. Mohawk St., Buffalo, N. Y.; Crescent Electric Co., 24th St. & Spring Alley, Pittsburg, Pa.; Macon & Mitchell, Waterbury, Conn.; Delta Star Electric Co., 541-553 Jackson Blvd., Chicago, Ill.; E. Steck, 1011 Chestnut St., Phila., Pa.

To Our Advertisers

It will improve your advertising and facilitate the service the publisher gives you if you will—

¶ Send new cuts frequently—preferably nickeltypes. Our large editions wear out copper electrotypes rapidly.

¶ Write your copy plainly, always in ink and preferably on the typewriter.

¶ Send your copy and cuts so they will reach our office not on the day the paper begins printing but at least ten days in advance of the date of the paper so we may have time to show proof.

¶ Kindly remember that it is difficult even for a publisher to make half-tone plates, necessary electros, set copy and show proofs all on the day the paper goes to press.

¶ Write your name plainly on the back of all cuts. We have received many that we could not identify for lack of this.

¶ Address advertising copy and cuts plainly to the "Advertising Department."

Electrical World

239 West 39th Street, New York

A quick canvass

of all the hotels, restaurants, theatres, churches, halls, laundries and factories in every A. C. territory will develop a great sale of

KIMBLE

A. C. reversible variable speed

FANS

The Kimble moves more air per dollar's worth of current than any other A. C. motor.

It is also the only variable speed motor requiring **no outside control,** and the only **reversible** A. C. fan motor in existence.

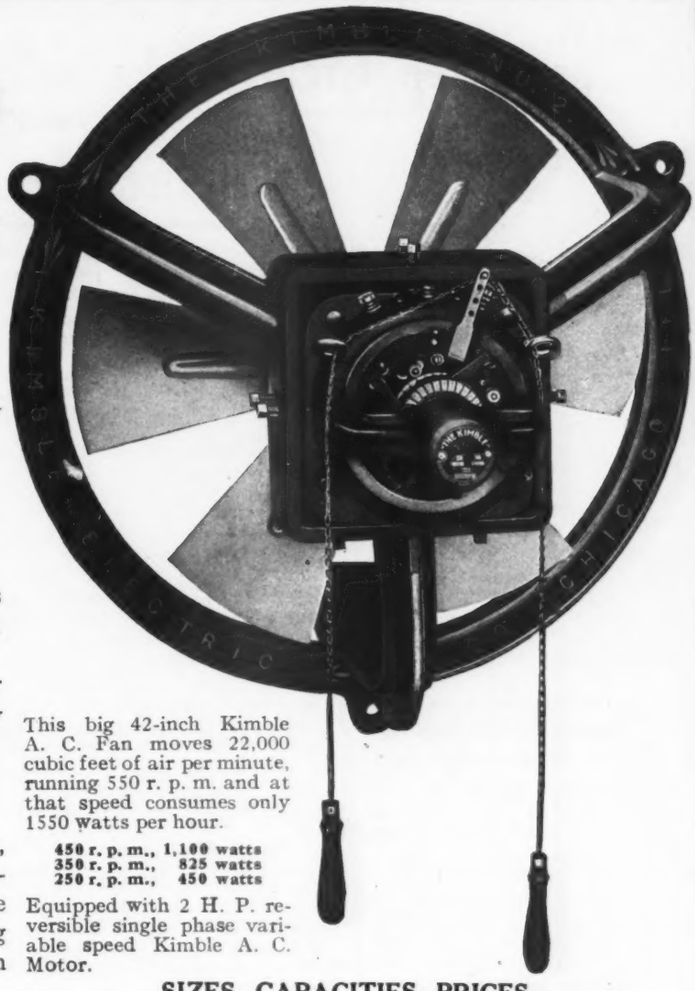
This means:

that with the Kimble fan you may, by pulling a chain, change your fan instantly from an exhaust fan to an intake fan and whether it is pushing or pulling the air, make it run at any speed from 80 r. p. m. up.

And every time you reduce the speed you reduce the power **cost.**

New Converts— Increased Revenue

These features will enable dealers and central station men to install fans in thousands of places where owners of premises had previously refused to put in fans because of their constant unvarying expense for current.



This big 42-inch Kimble A. C. Fan moves 22,000 cubic feet of air per minute, running 550 r. p. m. and at that speed consumes only 1550 watts per hour.

450 r. p. m., 1,100 watts
350 r. p. m., 825 watts
250 r. p. m., 450 watts

Equipped with 2 H. P. reversible single phase variable speed Kimble A. C. Motor.

SIZES, CAPACITIES, PRICES.
All 60 Cycle, Single Phase, 110 or 220 Volts A. C.

H. P.	Fan Diameter	R. P. M.	Cu. Ft. Air per Minute	Price
$\frac{1}{6}$	18 In.	80 to 800	2,500	$65.00
$\frac{1}{2}$	24 In.	80 to 750	6,000	90.00
1	30 In.	80 to 700	12,800	150.00
$1\frac{1}{2}$	36 In.	80 to 650	17,300	210.00
2	42 In.	80 to 550	22,000	275.00

Above capacities can be obtained only by using our straight blade aluminum fans. Blackman type fans are considerably lower in efficiency, and for that reason we supply our straight blade fans unless the Blackman type is specified.

Send for Catalog, and ask about our *two years'* guarantee.

KIMBLE ELECTRIC COMPANY

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KIMBLE ELECTRIC CO., Chicago:

Please send your Catalog on A. C. Motors and Fans.

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Electrical World, June 22, 1911.

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Standard PYRENE extinguisher is 3 inches in diameter, 14 inches long and weighs only five pounds.

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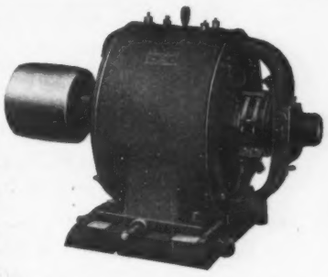
INDIVIDUALITY IN MOTORS



MOTORS of different makes develop characteristics good or bad, as the case may be, depending upon the design, or the care exercised in manufacture.

The fundamental characteristic of

Triumph Motors

is the SPLENDID COMMUTATION. They operate without sparking at any load within capacity of motor. This is the most important feature of any.

TRIUMPH ELECTRIC CO.

Cincinnati, Ohio

New York, Boston, Philadelphia, Baltimore, Chicago Pittsburg, Cleveland, St. Louis, St. Paul, New Orleans Chattanooga, San Francisco

COMPARE

your present freedom from commutator wear, flat spots and high mica, with the conditions you had to contend with before

"Le Carbone" Brushes

were introduced in this country. Although their first cost is greater than that of other carbon brushes, they are far more economical in the long run.

Write for partial list of Central Stations using "Le Carbone."

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3

High-Grade Carbon Brushes

The heads of a thousand dynamo rooms state positively over official signature that LE VALLEY VITAE CARBON BRUSHES

Actually save their first cost again and again;
Save time, labor and annoyance;
Save commutators, keeping them unscratched and glossy;
Save shut-down losses and repair bills;
Save and make reputations for men and machinery;

Are in fact the one absolutely proven, generally admitted high-grade Carbon Brush, worthy of complete dependence and exclusive use in all places under all circumstances.

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JORDAN COMMUTATOR TRUING DEVICE

This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short-circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award Jamestown Exposition. Write for catalog No. 3, with list of users, prices, etc.

Patented April 26, 1898; May 16, 1905; Sept. 6, 1910, and Jan. 24, 1911. Other patents pending.

Front View of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

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are of the MULTI-POLAR form, from 5 H.P. up

ESTABLISHED 1875

We call them MULTI-SPEED because speed changes are not made by steps, but an absolutely unbroken range is furnished between the highest and lowest points—in other words, every imaginable speed is given within these limits.

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It's the motor for locations laden with dampness or dust—metal, wood, wool, etc.

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are preeminently adapted for work under unfavorable conditions. ¼ to 10 H. P.

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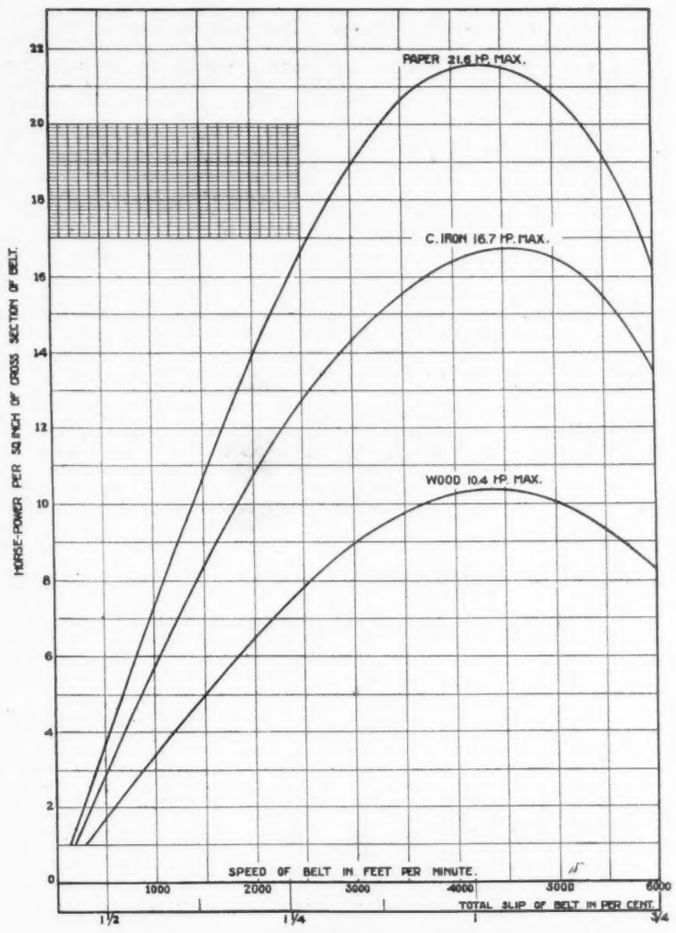
Some transmit better than others—you know that.



Belt Drives for Motors and Generators

At all speeds the tension in the tight side of the belt + ½ the tension in the slack side is constant. (300 lbs. per sq. inch cross-section.)

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If it's a

Rockwood Paper Pulley

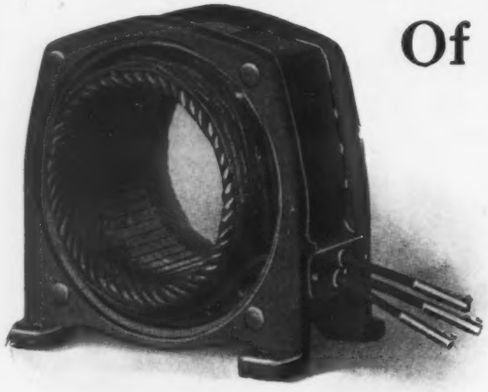
the difference is real—and big enough for your consideration.

Rockwood Paper Pulleys will transmit from 20 to 35% more power than cast-iron pulleys, and from 95 to 115% more power than wood pulleys.

Why not specify a Rockwood Paper Pulley on your next motor or generator drive.

THE ROCKWOOD MFG. CO., INDIANAPOLIS, IND., U. S. A.

REWINDING



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Commutators Refilled—Compensators, Transformers and Starting Boxes Repaired.

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REDUCED CURRENT CONSUMPTION

is invariably one result when motors are equipped with

Hess-Bright Ball Bearings

Some of the others are:
Constant Air-Gap
Always good Commutation
Greatly reduced repair bills.

Our catalog and data sheets are full of useful information.

Shall we send them?

The Hess-Bright Mfg. Co. 2112 Fairmount Ave., Philadelphia

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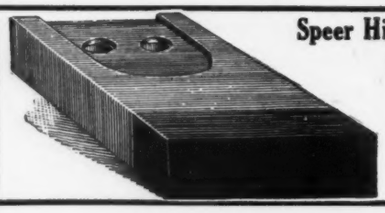

Speer High-Grade Brushes

have been adopted as standard by the largest manufacturers of electrical machinery in the United States.

Why Not You?

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St. Mary's, Pa.

Three excellent reasons why you should use

The Morse Chain

It can be run on short centers.

A reduction in the floor space of 750 square feet in one instance resulted in a saving of $1000 on the cost of a building, owing to this fact.

It requires practically no attention or repair.

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It has an efficiency of practically 99 per cent.

The efficiency of belt drive varies greatly averaging 90 to 95 per cent. This difference in efficiency will save enough to pay for a renewal of the chain when worn out.

The Morse Chain

is especially desirable where a large amount of power is to be transmitted, or where a compact, durable, efficient transmission, giving a large and positive speed ratio, is required.

See Catalogue No. 9

Morse Chain Co.

Ithaca, New York

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"We have been surprised at the great number of replies we have had to this advertisement, and also of the high character of the same."

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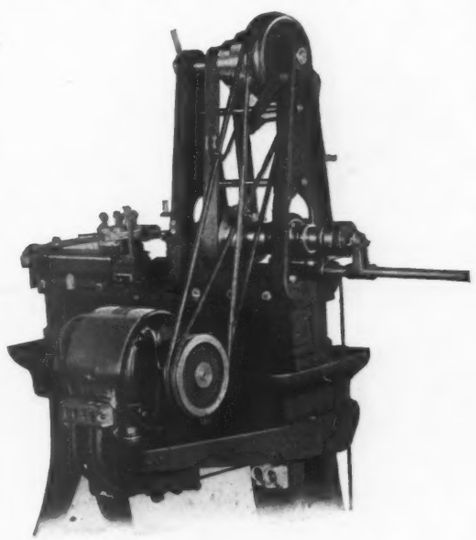
SAVE YOUR POWER

By Using

GARVIN Machine Tools Motor Driven

One of the advantages of driving machine tools by individual motors is the great saving of power. No overhead counter-shaft or line-shaft to eat up power and cause worry.

Machines driven by individual motors are economical, portable, always ready and good for over-time work. The power is reliable and may be had at all times.



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Motor Driven.

Use Code—Barbermot.

The Machine is well adapted for a large class of small manufactured electrical articles. Is simple, light running and easy to adjust. Realigned under all conditions of wear, accurate, and well built.

Capacity—5/8 in. x 3 in.

PROMPT DELIVERIES.

FOR FURTHER INFORMATION { ASK YOUR DEALER or WRITE US DIRECT

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Spring & Varick Sts., 45 Years in NEW YORK CITY

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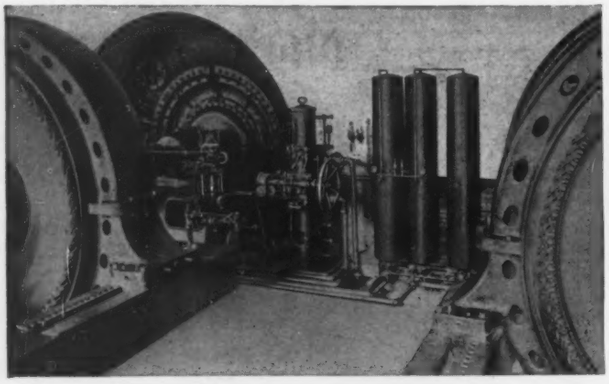
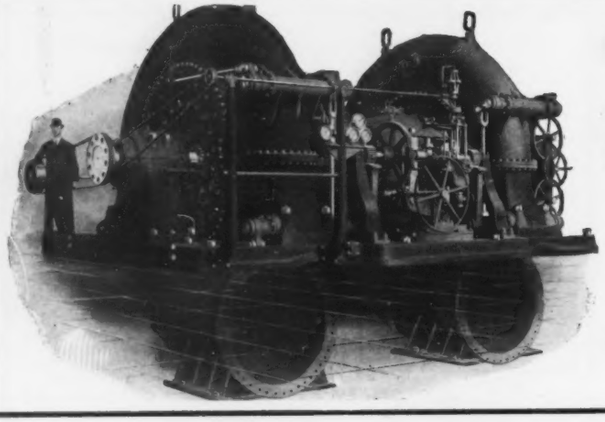


Naturally we like to furnish the whole governor

Sometimes other concerns have already installed the governor cylinders before we get a chance at it. The above picture shows one of five units in the plant of the Southern Power Co., Charlotte, N. C., where we took cylinders as we found them installed by another concern, equipped them with our centrifugal ball and relay valve mechanism and converted them into good governors. Maybe you have a similar proposition.

The Lombard Governor Company

Ashland, Mass.



ONE OF SIX UNITS

7200 H.P. each., 225 R. P. M., 100 feet head. Built for the Great Falls Water Power and Townsite Co., Great Falls, Montana. These turbines when tested in place gave an efficiency of 88% at 7-10 and 8-10 gate opening.

Francis Turbines of 145,000 H. P. now in daily use

Turbines designed to meet all requirements for heads from 3 ft. to 600 ft.

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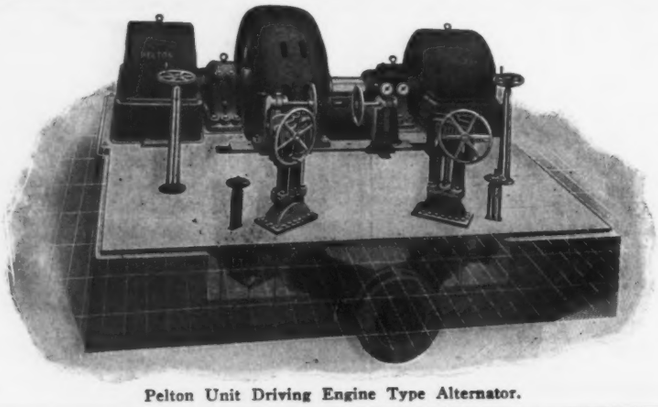

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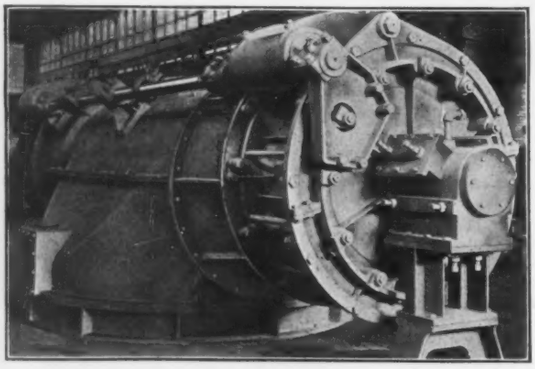

Samson Hydraulic Turbines

3000 Horse Power

This illustrates one of two units installed for the Virginia Passenger & Power Co., Richmond, Va. Each unit consists of SAMSON horizontal shaft turbines direct connected to generator. Head of water 25 feet, total capacity 3000 H. P. We would like the opportunity of bidding on your requirements in the way of turbines as we are fully prepared to furnish the latest and best design of turbine work. Shall we send you a catalog?

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3

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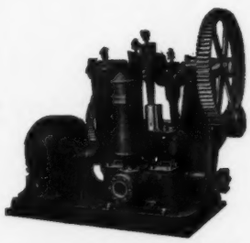
for Every Service



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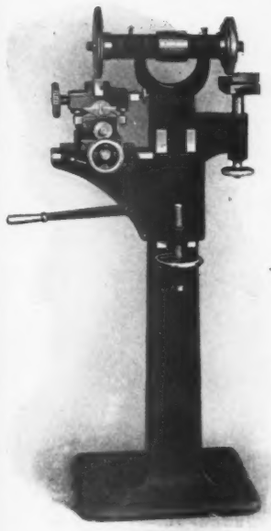
FORM "C" DRIVE Branches in all large cities 3

Geometric Chaser or Die Grinder



Not the cheapest Grinder on the market, but the most economical.

Will grind any make of chaser. Also has a second grinding wheel for ordinary tool grinding.

If you are interested, it will be to your advantage to secure one of these machines now, while the introductory price is on.

A booklet describing this machine will be sent you on request.

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The Athens (Mich.) Mill & Power Co., write us: "We have no fault to find with your governor whatever. It does the work right up to the A-1 mark." You'll never realize full power value without a

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Waterwheel Governor

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In Vertical or Horizontal, Single or Multi-Wheel Units
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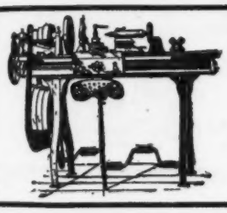

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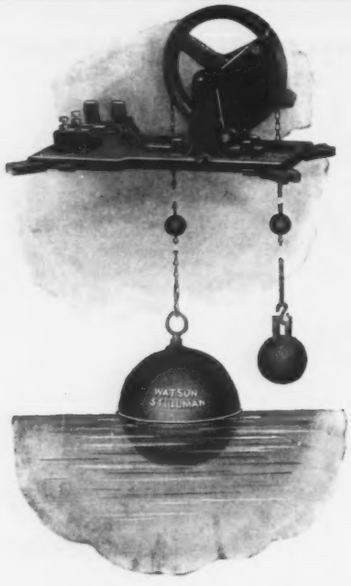

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The combination of a motor-driven Twinvolute Pump with Watson-Stillman Automatic Tank Switch is ideal for automatically maintaining the water level between fixed limits in any tank or sump. The switch in the tank (shown above) starts the pump motor when the water gets low and stops it as the level approaches the desired height and vice versa for sump work.

No other pump than the Watson-Stillman Twinvolute requires so little attention and repairs and makes so little noise in this service. The saving of space and power here as elsewhere is a notable feature of Twinvolute Pumps, for the twinvolute waterway (patented) does away with the errors of unequal work, pressure, velocity and objectionable eddies.

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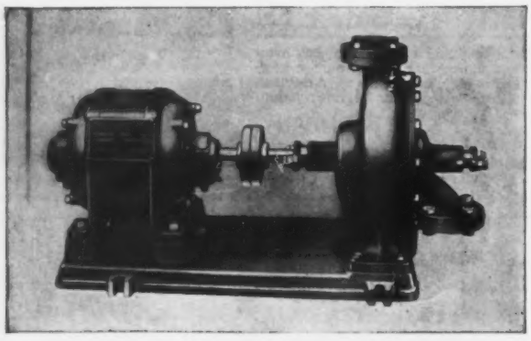

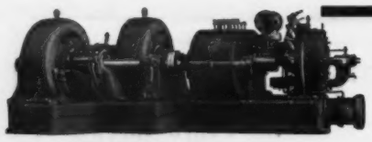

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IN this De Laval Turbine-driven generating set the D.C. generators are standard-speed machines, substantial, reliable, free from vibration, and having overload capacities. High speed generators for direct connection to turbines without gears are on the other hand limited in diameter by the speed at which they run, require extra long or double commutators with insufficient space between brushes, have insufficient area for conductors and insulation, are difficult to balance, and specially subject to unbalancing, and can be rebalanced or repaired only by the manufacturer.

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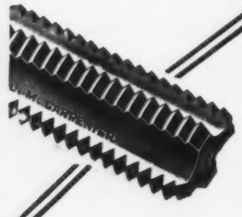

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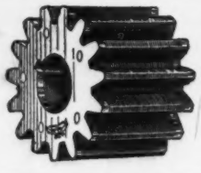

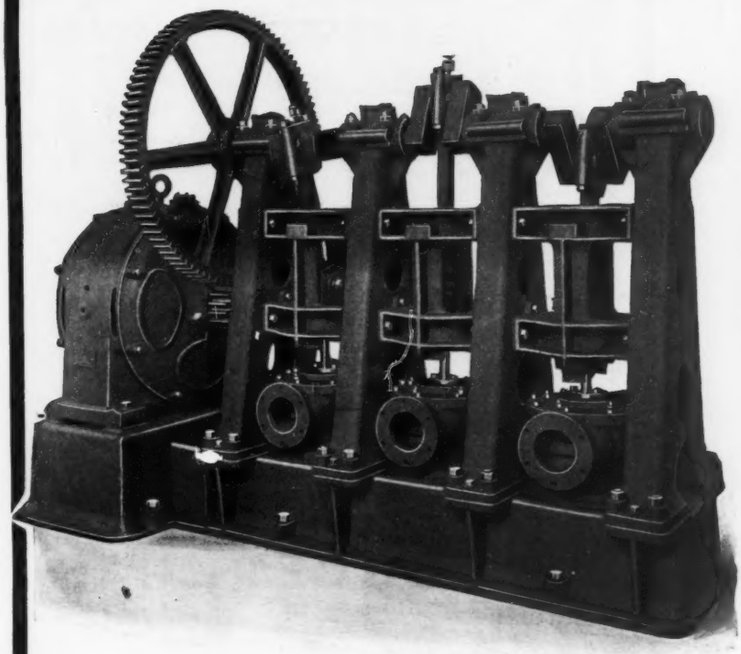

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For Large Power and Electric Light Stations—

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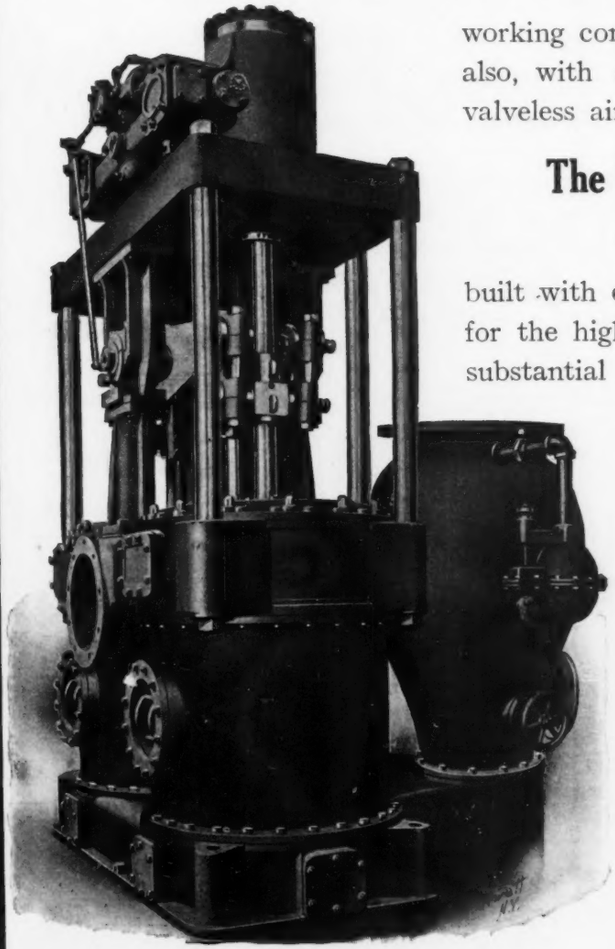
are compact, self-contained and accessible. Important features embodied in the construction of the air cylinders insure the best working conditions and increased efficiency. Built, also, with duplex cylinders, double-acting suction valveless air cylinders, and for belt or steam drive.



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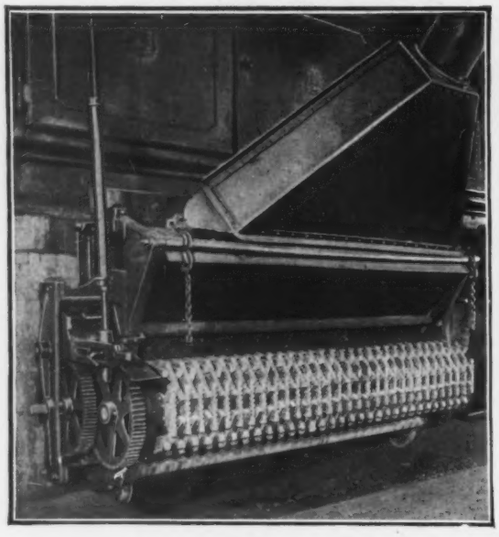
What a Mechanical Stoker Will Do



is of far more importance than what *it is*. Most any sort of a foundry can make castings. Any machine shop can turn out parts. Any mechanic can assemble them. Then what?

Here are some of the things that the

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Burn low grades of coal with greater steam-producing results than any other method of stoking.

Burn successfully coals which "clinker" on any other grate.

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Give uniform boiler temperature at all times.

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Eliminate all smoke.

Always keep grate surface clear and clean; never require hand-cleaning.

Notwithstanding its mechanical perfections, *it will not* accomplish these results unless conditions, as a whole, are suited to use of a stoker.

And *that* is why automatic stoking is an engineering problem.

And *that* is why we will not, as manufacturers, recommend the installation of a Green Chain Grate Stoker unless our engineering experience and knowledge convince us that conditions can be modified or provided, to assure that the operation of our Stoker will be profitable to our customer, as well as a credit to our product and its installation.

This policy has put in successful use over One Million Horse Power of Green Chain Grate Stokers.

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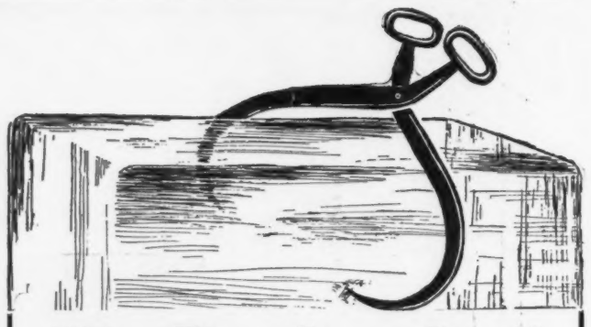

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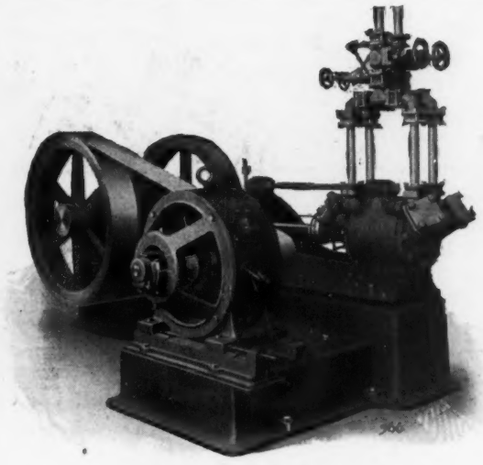

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Why not utilize your idle generator capacity to make ice of your exhaust (condensed) steam, by operating the motor-driven ammonia compressors of a

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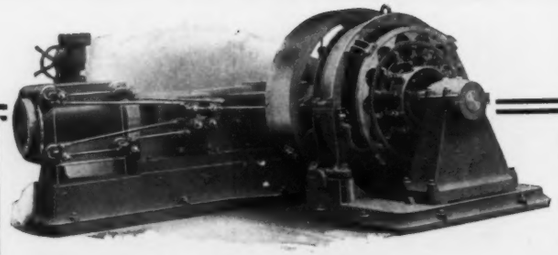

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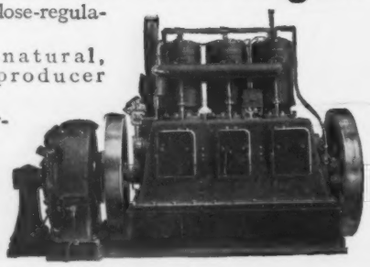

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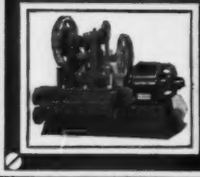

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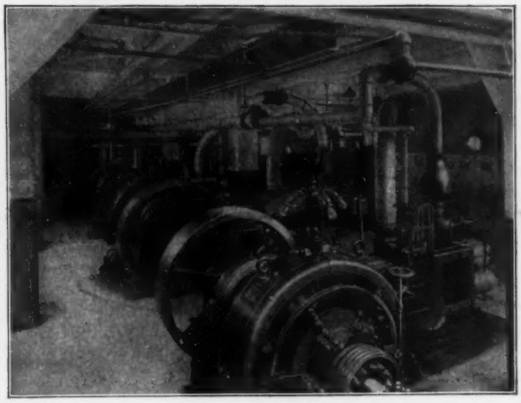

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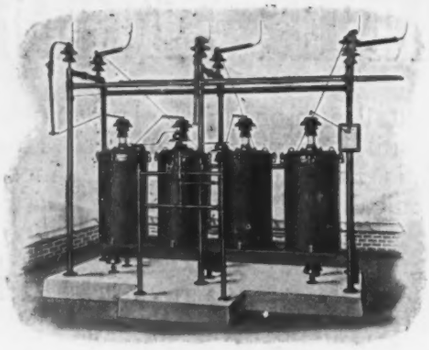

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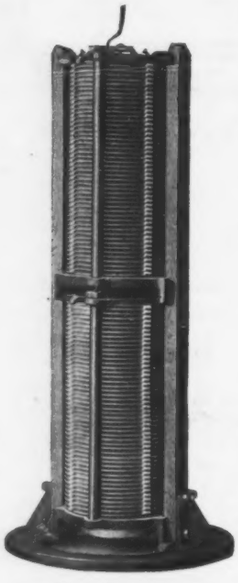

Tray Structure.

Particular attention is invited to the improved method of supporting the aluminum trays.

Four porcelain separators are arranged between each successive pair of trays. Each stack of trays is then clamped with iron bolts turning on the threaded ends of the wooden tie rods. No wooden part of the structure comes in contact with the trays.

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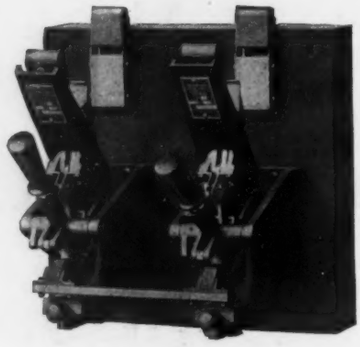
Protective apparatus suitable for every specific requirement is described in circular No. 1132.



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These breakers are particularly suited for use on lighting circuits and for power circuits where the breaker is not exposed to acid, fumes or excessive dust and dirt of any character.

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